

EXHIBIT 10

THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

convenes the

EXPERT PANEL MEETING

Analysis and Historical Reconstruction of
Groundwater Resources and Distribution of
Drinking Water at Hadnot Point, Holcomb
Boulevard and Vicinity, U.S. Marine Corps
Base, Camp Lejeune, North Carolina

APRIL 30, 2009

The verbatim transcript of the Expert Panel Meeting
held at the ATSDR, Chamblee Building 106,
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2009.

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C O N T E N T S

April 30, 2009

| | |
|--|-----|
| HOUSEKEEPING RULES MORRIS L. MASLIA | 10 |
| RE-INTRODUCTION OF PANEL AND SUMMARY OF DAY 1 ISSUES AND DISCUSSION PANEL CHAIR, DR. ROBERT M. CLARK | 13 |
| WATER-DISTRIBUTION SYSTEM MODELING JASON SAUTNER (a) REVIEW AND OVERVIEW OF MODELS FOR HADNOT POINT AND HOLCOMB BOULEVARD (b) INTERCONNECTION OF HADNOT POINT AND HOLCOMB BOULEVARD SYSTEMS | 14 |
| PANEL DISCUSSION: WATER-DISTRIBUTION SYSTEM MODELING | 44 |
| PANEL DISCUSSION: WATER-DISTRIBUTION SYSTEM MODELING (RECOMMENDATIONS FROM THE PANEL) | 113 |
| DATA DISCOVERY - ADDITIONAL INFORMATION AND DATA MORRIS MASLIA AND FRANK BOVE | 167 |
| PANEL DISCUSSION: INCORPORATING AND USING ADDITIONAL INFORMATION AND DATA | 192 |
| CHAIR SOLICITS RESPONSE TO CHARGE FROM EACH PANEL MEMBER PANEL CHAIR AND MEMBERS | 223 |
| COURT REPORTER'S CERTIFICATE | 277 |

TRANSCRIPT LEGEND

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-- "*" denotes a spelling based on phonetics, without reference available.

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-- “[-ed.]” represents a correction made by the editor

EXPERT PANEL

Analysis and Historical Reconstruction of
Groundwater Resources and Distribution of Drinking Water
at Hadnot Point and Holcomb Boulevard and Vicinity, U.S.
Marine Corps Base, Camp Lejeune, North Carolina.

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Glossary of Acronyms and Abbreviations

| | |
|-----------------------------|--|
| ASCE | American Society of Civil Engineers |
| AST | above ground storage tank |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| AWWA | American Water Works Association |
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| CAP | community assistance panel |
| CD-ROM | compact disc, read-only-memory |
| CERCLA and Liability Act | Comprehensive Environmental Response, Compensation, and Liability Act |
| CI | cast iron |
| DCE | DCE: dichloroethylene |
| | 1,1- |
| DCE: | 1,1-dichloroethylene or 1,1-dichloroethene |
| | 1,2- |
| DCE: | 1,2-dichloroethylene or 1,2-dichloroethene |
| | 1,2- |
| cDCE: | <i>cis</i> -1,2-dichloroethylene or <i>cis</i> -1,2-dichloroethene |
| | 1,2- |
| tDCE: | <i>trans</i> -1,2-dichloroethylene or <i>trans</i> -1,2-dichloroethene |
| DHAC | Division of Health Assessment and Consultation, ATSDR |
| DOD | U.S. Department of Defense |
| DON | U.S. Department of Navy |
| EPANET or EPANET 2 | a water-distribution system model developed by the EPA |
| ERG | Eastern Research Group, Inc. |
| gal | gallons |
| gpm | gallons per minute |
| HPIA | Hadnot Point Industrial Area |
| HUF | hydrologic unit flow |
| IRP | installation restoration program |
| LGR | local-grid refinement |
| MESL | Multimedia Environmental Simulations Laboratory, Georgia Institute of Technology |
| MGD | million gallons per day |
| µg/L | micrograms per liter |
| MODFLOW | a three-dimensional groundwater flow model developed by the U.S. Geological Survey |
| MODPATH | a particle-tracking model developed by the U.S. Geological Survey that computes three-dimensional pathlines and particle arrival times at pumping wells based on the advective flow output of MODFLOW |
| MT3DMS | a three-dimensional mass transport, multispecies model developed by C. Zheng and P. Wang on behalf of the |

| | | |
|----|-----------------------|---|
| 1 | | U.S. Army Engineer Research and Development Center, |
| 2 | | Vicksburg, Mississippi |
| 3 | NAVFAC | Naval Facilities Engineering Command |
| 4 | NCEH | National Center for Environmental Health, U.S. Centers |
| 5 | | for Disease Control and Prevention |
| 6 | NTD | neural tube defect |
| 7 | PCE | tetrachloroethylene, tetrachlorethene, PERC® or PERK® |
| 8 | PEST | a model-independent parameter estimation and |
| 9 | | uncertainty analysis tool developed by Watermark |
| 10 | | Numerical Computing |
| 11 | ppb | parts per billion |
| 12 | PVC | polyvinyl chloride |
| 13 | SGA | small for gestational age |
| 14 | Surfer® | a software program used for mapping contaminant |
| 15 | plumes in groundwater | |
| 16 | TCE | trichloroethylene, 1,1,2-trichloroethene, or 1,1,2- |
| 17 | trichloroethylene | |
| 18 | TechFlowMP | a three-dimensional multiphase multispecies contaminant |
| 19 | | fate and transport analysis software for subsurface |
| 20 | | systems developed at the Multimedia Environmental |
| 21 | | Simulations Laboratory (MESL) Research Center at |
| 22 | | Georgia Tech |
| 23 | TTHM | total trihalomethane |
| 24 | USEPA | U.S. Environmental Protection Agency |
| 25 | USMC | U.S. Marine Corps |
| 26 | USGS | U.S. Geological Survey |
| 27 | USPHS | U.S. Public Health Service |
| 28 | UST | underground storage tank |
| 29 | VC | vinyl chloride |
| 30 | VOC | volatile organic compound |
| 31 | WTP | water treatment plant |
| 32 | | |
| 33 | | |

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P R O C E E D I N G S

(8:15 a.m.)

HOUSEKEEPING RULES

DR. CLARK: Morris has got a couple of things that he wanted to go over, sort of general issues. One thing that we had talked about is if ~~I don't know~~ [-ed.] whether Scott can finish his presentation perhaps during lunchtime if that would be possible.

How long would it take? About 15 minutes or so to --

DR. BAIR: Ten or 12.

DR. CLARK: Okay, we'll try to work that out because I think you were right at the point, sort of the punch line, and we sort of missed that, very interesting.

Morris, you have a couple things you want to say?

MR. MASLIA: First of all I wanted to thank Barbara for bringing in the biscuits and all that this morning. That was a welcome treat, and Rene, ~~and Rene,~~ [-ed.] and also our staff, Kathy Hemphill, Rachel Rogers and Liz for administrative help in getting things going.

1 Second of all, for those who are
2 turning in or traveling on ERG's money, you
3 can mail in your receipts to Liz when you get
4 back or e-mail them or however you want to do
5 that. Then thirdly, and perhaps this was a
6 misunderstanding but hopefully we can clear it
7 up to this morning. I wanted to make sure
8 everyone understood that the notebooks and the
9 materials that were sent to you were not
10 intended to imply they were anywhere near
11 completion.

12 I think that impression may have been
13 observed because we gave a time schedule and
14 it showed we were planning originally to be
15 finished by December of 2009. So that was not
16 the intent. I apologize if that message sort
17 of came about to appear and to sort of
18 demonstrate we talked a lot about Table C-7
19 through C-13 yesterday so I printed them out
20 for you.

21 And if you go to any one of the
22 tables, even the last table, you'll see that
23 it takes seven, eight, nine, ten, 12, a dozen,
24 couple dozen files just to compile the data
25 for one table. So the files are massive to go

1 through, and so this was sort of our
2 compilation of data that we had completed.

3 And it was not intended to imply that
4 we are ready to send this thing out for
5 clearance or peer review or anything like
6 that. It was really to get your feedback, and
7 in fact, feedback in terms of the timeline and
8 everything else. So hopefully, that clears
9 that up, and I think that is about all.

10 We really want to try to stick to the
11 schedule. We did pretty good yesterday.
12 Today, because I know some people have some
13 near five o'clock or six o'clock flights, so
14 we do want to do the final round of input from
15 the panel, which we're looking forward to the
16 recommendations to the Agency that, I believe
17 is scheduled to begin at 2:30.

18 So with that, that's all I have to
19 say, and Mr. Chair, I will -- oh, and they
20 have asked us, we are having audio problems if
21 you're watching it on streaming, and they've
22 asked that you clip the remote onto your belt
23 and the lapel up here, not hang this in a
24 shirt or in your pocket or anything like that.
25 So with that, we're up, is Jason ready?

1 **RE-INTRODUCTION OF PANEL AND SUMMARY OF DAY 1**

2 **ISSUES AND DISCUSSION**

3 **DR. CLARK:** One thing I want to do just for
4 the record is go around the room and have
5 everybody give their name so we know who's in
6 attendance officially. So I'll start with
7 Randall.

8 **DR. ROSS:** Randall Ross, U.S. EPA.

9 **DR. KONIKOW:** Lenny Konikow, U.S. Geological
10 Survey.

11 **DR. GOVINDARAJU:** Rao Govindaraju, Purdue
12 University.

13 **MR. HARDING:** Ben Harding, AMEC Earth and
14 Environmental.

15 **DR. CLAPP:** Dick Clapp, Boston University.

16 **DR. POMMERENK:** Peter Pommerenk.

17 **DR. WARTENBERG:** Dan Wartenberg, Robert Wood
18 Johnson Medical School.

19 **DR. BAIR:** Scott Bair, Ohio State
20 University.

21 **DR. ASCHENGRAU:** Ann Aschengrau, Boston
22 University.

23 **DR. DOUGHERTY:** Dave Dougherty, Subterranean
24 Research.

25 **DR. HILL:** Mary Hill, U.S. Geological

1 Survey.

2 DR. GRAYMAN: Walter Grayman, Consulting
3 Engineer, Cincinnati.

4 DR. CLARK: And I'm Bob Clark.

5 We're going to start off this morning
6 with a discussion of water distribution system
7 modeling. Heard a lot about groundwater
8 yesterday.

9 Jason, you're up.

10 **WATER-DISTRIBUTION SYSTEM MODELING**

11 MR. SAUTNER: Can everyone hear me? Is this
12 on? Is that better?

13 Today I'm going to talk about the
14 historical reconstruction of the water
15 distribution systems, and just as an overview
16 I'll go over some background. I think many of
17 you have a good idea about the background from
18 discussions yesterday, and then I'll go into
19 more of the water distribution system
20 modeling. It's going to be an all-pipes
21 calibration. I'll go into the
22 interconnection, which is going to be a big
23 topic, of transfer of water between systems.
24 And then I'll go into some historical
25 reconstruction and talk about some preliminary

1 scenario results.

2 Overall, the water treatment plant
3 service areas, we have Hadnot Point, which
4 everyone knows about. It's 74 miles of
5 pipelines. Approximately 71 percent of it is
6 PVC. There's four elevated tanks. The
7 controlling tank is SFC-314, which is right
8 down in here in this area. All of the
9 elevated tanks are 300,000 gallons. Delivered
10 water is approximately 2.3 million gallons per
11 day in 2004.

12 And then we have the Holcomb Boulevard
13 system up here. It's about 73 miles of
14 pipelines, approximately 67 percent cast iron.
15 There's three elevated tanks. The controlling
16 tank is right up here. It's Paradise Point
17 S2323. It's a 200,000 gallon tank. And the
18 delivered water in Holcomb Boulevard was
19 approximately one million gallons per day in
20 2004. And there's two interconnections which
21 we talked about. The Wallace Creek, which I
22 guess now we're going to call the Marston
23 Pavilion to avoid confusion. And that's the
24 bypass valve located right here. And then we
25 also have booster pump 742, which is a 700

1 gallon per minute booster pump.

2 Some significant events that occurred
3 between 1941 through 1987: In 1941, the
4 Hadnot Point water treatment plant comes
5 online, which is located right here. In 1952,
6 the Tarawa Terrace treatment plant came
7 online. I don't have the Tarawa Terrace water
8 distribution system model on here, but it's
9 located right up here. And in '72, the
10 Holcomb Boulevard water treatment plant,
11 located right here, came online in June of
12 '72.

13 From November of '84 through February
14 of '85 is when most of the several supply
15 wells were shut down due to VOC contamination.
16 And January 27th through February 4th of '85,
17 there was about a nine-day period where the
18 Marston Pavilion bypass valve was open
19 continuously. In 1987, the Holcomb Boulevard
20 water treatment plant was expanded to provide
21 water to the Tarawa Terrace and Camp Johnson
22 areas. And in 1987, the Tarawa Terrace water
23 treatment plant was taken out of service.

24 As for the Hadnot Point water
25 distribution model, it's an all-pipes model.

1 We used EPANET. I think many of you are aware
2 with EPANET and its capabilities. It
3 simulates spatially distributed contaminant
4 concentrations throughout the network, and it
5 can perform extended period simulations of
6 hydraulic and water quality behavior within
7 the network.

8 The Hadnot Point model consists of
9 about 3,900 junctions, about 4,000 pipes. And
10 what we did was we conducted a hydraulic and
11 water quality field test May 24th through 27th
12 of 2004. During this test we collected and
13 recorded hydraulic data, such as pressure and
14 flow. And we also injected a calcium chloride
15 and sodium fluoride at the water treatment
16 plant, which was our source location. And we
17 measured this continuously throughout
18 locations in the distribution system.

19 Here are some calibration results.
20 The Hadnot Point, the model was initially run
21 using a single demand pattern. And this was
22 obtained from a water balance on the
23 distribution system. Eventually what we did
24 was we used the PEST model to estimate eight
25 different well, we aggregated eight different

1 demand patterns throughout using the Water
2 Conservation Analysis Report from 1999 in
3 which they estimated water usage in different
4 zones, and we allocated eight different
5 groups. And by using PEST we estimated
6 different 24-hour demand patterns.

7 The blue dots on this graph show the
8 SCADA data, which is what we recorded in the
9 field. It's actual water level data at SFC-
10 314, which is the controlling tank at Hadnot
11 Point. The red line is simulated data from
12 the water balance, and the green line, which
13 is a little difficult to see here, is the PEST
14 water level simulation data. And you can see
15 that the fit got much better by using PEST.

16 Over here we have some concentration
17 graphs.

18 **DR. HILL:** With PEST what was it you were
19 estimating? What values were you changing to
20 create that fit?

21 **MR. SAUTNER:** The 24-hour demand patterns,
22 and it was actually a colleague of ours,
23 Claudia Valenzuela that did the PEST modeling.
24 So we have a full report on it and details of
25 how she conducted it.

1 Here is fluoride concentration just at
2 a random logger that I chose in the system.
3 You can see the blue line is what our
4 continuous monitor recorded, and the red line
5 is what we're simulating. And the same down
6 here with the chloride concentration. The
7 blue line still is field data from what we
8 recorded on the continuous monitor, and the
9 red line is the simulation.

10 **MR. HARDING:** Jason, can I ask you a
11 question?

12 **MR. SAUTNER:** Yes.

13 **MR. HARDING:** On that, was that a four- or
14 five-day period that you, yeah. Did you, if I
15 recall what you said, you said you had eight
16 different classifications for water demand --

17 **MR. SAUTNER:** Correct.

18 **MR. HARDING:** -- diurnal patterns, right?
19 Did you use the same pattern? Did you
20 calibrate one pattern that was used on the
21 24th, 25th, 26th or did you calibrate a five-day
22 pattern that -- you see what I'm saying?

23 **MR. SAUTNER:** Yeah, that's what Claudia did.
24 I'm not exactly sure of how she did the
25 calibrations for the PEST.

1 **MR. HARDING:** What I'm getting at is if you
2 calibrate an exact pattern for these five
3 days, that's the best fit for those five days,
4 you're not going to be able to extrapolate
5 that to other periods of time when you don't
6 have calibration data. You're going to have
7 to have a pattern that you can use going back
8 in time, and typically you have one 24-hour
9 pattern for each category of use.

10 **MR. SAUTNER:** Right, and I'll get into this
11 a little later. We assume that generally
12 throughout both the distribution systems that
13 the demand patterns didn't really change much.
14 There was, I mean, historically. While there
15 were significant changes that I showed you in
16 that list of significant changes throughout
17 the systems, overall demand in the systems
18 didn't change much.

19 **MR. HARDING:** Yeah, that's fine, but I guess
20 what I'm getting at is, is that if you are
21 going to take a single 24-hour pattern for
22 each of eight categories of use, then that's
23 the way the calibration results ought to be
24 shown. In other words the same pattern should
25 be used on the 24th, 25th, 26th, so on and so

1 forth.

2 **MR. SAUTNER:** Okay, you're saying a 24-hour
3 average of this.

4 **MR. HARDING:** Well, I don't know. You said
5 you didn't know how she did it. Because you
6 could fit it both ways. You could fit it to
7 look at the, what is it, the five days -- I
8 haven't done the math -- yeah, five days
9 altogether or you could fit it to a single 24-
10 hour period and then replicate that period.
11 And that's what you're going to have to do --

12 **MR. SAUTNER:** Right, for historical extended
13 simulations.

14 **MR. HARDING:** Right, so you just need to --
15 I don't know how you did it, and it sounds
16 like you don't know, but the way you should do
17 it is to do your calibration exactly the way
18 you're going to do your extrapolated
19 simulations.

20 **MR. MASLIA:** (off microphone) But the way
21 the PEST model was run, because we've got all
22 the files and stuff like that is we ran it for
23 the entire period of the test. We put in what
24 we thought were the initial ^ [diurnal
25 patterns -ed.], and we did that based on five

1 ^ [days -ed.]. Then we ran a test based on
2 continuous water levels throughout the entire
3 test period to go in and adjust ^ [the diurnal
4 -ed.] patterns and we got a five-day length of
5 time ^.

6 **MR. HARDING:** Yeah, and the problem with
7 this is it violates Mary's first law, which is
8 it looks scary. And it's too good a fit,
9 right? And the reason is, is that you've
10 fitted every hour of the water demand to the,
11 and so what you should do, because you're not
12 going to be able to do that in 1969 and '70.
13 So what you should do, at least this is my
14 recommendation -- Walter can weigh in -- but
15 you should fit a 24-hour pattern for each
16 category of use just like you started out
17 with. But you're going to get one that's
18 fitted, and then replicate that over the five
19 days and see how your calibration works.
20 That's what I suggest.

21 **MR. MASLIA:** But you have your data that
22 you're measuring will vary over, during the
23 test.

24 **MR. HARDING:** Right, it's going to vary. I
25 mean, people don't behave exactly the same way

1 each day, and when you look at, when you
2 compare your idealized pattern to the actual
3 pattern, it's not going to be the same in
4 life. But this five-day pattern isn't going
5 to be the same five-day pattern you see on May
6 24th of 1972, for example.

7 **DR. GRAYMAN:** Yeah, I agree with you, though
8 what I'd like to see is that graph and then do
9 the next step which take what would be the
10 best repeating 24-hour pattern and see how
11 that works. And I guess the other question on
12 it is what does, the resulting best-fit demand
13 patterns, do they look reasonable or are they,
14 in effect, just --

15 **MR. SAUTNER:** Do you mean the demand
16 patterns in terms of diurnal demand patterns?

17 **DR. GRAYMAN:** Yeah.

18 **MR. SAUTNER:** Yeah, they're all reasonable.

19 **DR. GRAYMAN:** But in the end you do want to
20 come up with a repeating 24-hour pattern,
21 which you can then use for future or past
22 modeling.

23 **DR. HILL:** So on these other years when you
24 don't have so much data, what data do you
25 have?

1 **MR. SAUTNER:** Well, I'll get into the
2 historical reconstruction later in the
3 discussion --

4 **DR. HILL:** Okay, as you go. And just one
5 thought about, you might do instead of a daily
6 pattern repeated, you might do a weekly
7 pattern.

8 **MR. SAUTNER:** That's one thing I also
9 thought of because for the Holcomb Boulevard,
10 which I'll show you next, we have a longer
11 period of time.

12 So the Holcomb Boulevard system has
13 about 4,800 junctions, 4,900 pipes, and we did
14 a field test in which we just shut off the
15 fluoride feed at the water treatment plant, at
16 the Holcomb Boulevard water treatment plant.
17 We shut it off and watched it drop down to
18 background levels to about 0.2 micrograms per
19 liter, and then we turned it back on and
20 watched it go back up.

21 This test was, we did about a 21-day
22 test with continuous monitors out there. You
23 can see the date here is about September 23rd,
24 2004 through -- oh, I only have four days
25 showing here, but the test did go from

1 September 23rd 'til October 11th or 12th. On
2 this graph I just represented four days of
3 data. And similarly, the blue dots are the
4 SCADA data, which is what the operation rooms
5 recorded. The red line was simulated from the
6 water balance, and the green line was
7 simulated from PEST.

8 **DR. HILL:** I'm sorry. I may have missed it.
9 But how do you get the water -- what --

10 **MR. SAUTNER:** Water balance?

11 **DR. HILL:** The water balance, where does
12 that come from?

13 **MR. SAUTNER:** That's just, it's taking
14 what's stored in the tanks, how much water's
15 delivered to the system, what the demand is on
16 the system and during, you know, adding,
17 subtracting and determining how much water was
18 used in the system basically.

19 Is that an easy way to describe it,
20 Walter?

21 **DR. GRAYMAN:** (off microphone) And then use
22 a single common pattern, ^ [diurnal -ed]
23 pattern for all ^[days -ed.].

24 **MR. HARDING:** Yeah, that's the difference,
25 Mary. They have one pattern, and then they're

1 going to break it down to different categories
2 of use.

3 **MR. SAUTNER:** Right.

4 **MR. MASLIA:** Jason, I think it's important
5 to point out, and Mary, initially, where the
6 patterns were derived from is each military
7 installation had a water use survey done.
8 They used a, a program was developed to really
9 see how they could conserve, it was a
10 conservation study. And the conservation
11 study basically provides a gross amount on the
12 average daily usage, what showers are being
13 used, what swimming pools are being used. And
14 so to start this effort off we derived initial
15 estimates from those values to get the model
16 going.

17 **MR. SAUTNER:** Thank you, Morris.

18 I know again it looks like this file
19 lacks Mary's first law; however, I guess I
20 should have chosen a different graph. This
21 one is located close to the source so you're
22 going to get better results right near the
23 source.

24 You can see the, so now we have the
25 date here from September 23rd through October

1 11th around. And you can see the fluoride
2 concentration's starting out around one
3 microgram per liter dropping down to about 0.2
4 and then going back up to one.

5 Here's some, I guess this is a little
6 misleading. It says PEST-derived demand
7 factors is actually the allocations, the
8 different categories that we used. The red is
9 bachelor housing. There's a gray, which is
10 the cooling system. The light blue is family
11 housing. There's a heating plant, vehicle
12 washing, office and work areas. And
13 unfortunately, I don't think this is in the
14 packet that you have of my slides. I added
15 this one.

16 Now I'll get into some
17 interconnections discussions.

18 **MR. HARDING:** Jason, so how did you then
19 allocate spatially to the nodes, the base
20 demand that you varied with your diurnal
21 pattern? How did you allocate across the
22 categories? Did you do a separate demand
23 pattern for each node?

24 **MR. SAUTNER:** No, no, no. There's eight
25 different patterns, so depending on what

1 location, you know, each node was identified
2 as, it would get a certain pattern.

3 **MR. HARDING:** Those were in actual use. I
4 see what you're saying.

5 **MR. SAUTNER:** So now interconnections, which
6 I guess is going to be a big discussion. As
7 you know there are two interconnections, the
8 Wallace Creek, which we're calling Marston
9 Pavilion now, and the booster pump 742.

10 It was originally thought that Marston
11 Pavilion bypass valve and the booster pump 742
12 were operated only on very rare occasions and
13 solely for emergency situations. However,
14 additional data discovery and discussions with
15 both former and current water utility staff
16 have led us to believe that historically water
17 was transferred from Hadnot Point to Holcomb
18 Boulevard more frequently than originally
19 thought.

20 As previously mentioned, the Marston
21 Pavilion bypass valve was not easily accessed
22 so it was not typically open long enough to be
23 considered a significant source of water
24 transfer. Basically, the historical scenarios
25 that I've constructed, I don't open the bypass

1 valve; however, through suggestions we can
2 open it and run different scenarios just to
3 see how the water reacts going through there.

4 As Ben pointed out, I think he alluded
5 to yesterday, if you were to turn on the 700
6 gallon booster pump, and you had that bypass
7 valve open, water is simply just going to go
8 right back down. And I saw that. I ran a
9 scenario. Exactly what you said happened.

10 However, there was that about a nine-
11 day period from January 27th through February
12 4th where that Marston Pavilion bypass valve
13 was open for about nine consecutive straight
14 days, and from the logbooks and discussions
15 with the water utility staff, we determined
16 that booster pump 742 was generally used
17 during late spring and early summer months to
18 account for irrigating the Scarlet Golf
19 Course.

20 There was actually two golf courses
21 loaded up, located in Holcomb Boulevard, and
22 that created such a demand on the Holcomb
23 Boulevard system that water needed to be sent
24 from Hadnot Point to Holcomb Boulevard.

25 **DR. GRAYMAN:** Jason, can I ask a question?

1 During that long period, what was it, nine
2 days?

3 **MR. SAUTNER:** Uh-huh.

4 **DR. GRAYMAN:** Was the booster pump running,
5 too?

6 **MR. SAUTNER:** That's another thing, I'm not
7 sure of. Logbooks, we were told that whenever
8 the bypass valve was open, the booster pump
9 was always running first. If the booster pump
10 couldn't supply enough water, they would open
11 the bypass valve. I don't understand, as what
12 I just discussed your scenario of if you have
13 the booster pump pumping and you open the
14 valve, water's simply going to go back down.

15 **MR. HARDING:** Well, nobody could see the way
16 the water's flowing. There's no
17 instrumentation or anything to reveal this, so
18 people misunderstood the value of opening the
19 valve, and it actually was a counterproductive
20 action. So it would cause the penetration of
21 the water from the booster pump to happen much
22 faster. Right, Walter?

23 **DR. GRAYMAN:** Well, I think we need to
24 establish, I assume there are pumps at each of
25 the treatment plants essentially that are

1 pumping the water from the treatment plant up
2 to the tanks, which is the gray line in those
3 two. And I'm guessing that the gray line is
4 probably fairly similar between the two or the
5 normal water levels in the tanks are they the
6 same in Hadnot Point as they are in Holcomb
7 Boulevard?

8 **MR. SAUTNER:** I believe they're fairly the
9 same.

10 **DR. GRAYMAN:** And so then they'll put the
11 booster pump on just essentially it's
12 dedicated to moving the water from the
13 treatment plant in Hadnot Point into the
14 Holcomb system. And so whether the direction
15 the water's going to be going if they open the
16 bypass is really going to depend on what the
17 water levels are in the two tanks and what the
18 demands are. So you may not necessarily get a
19 circulating system.

20 **MR. SAUTNER:** Right, if you had lower levels
21 in the Holcomb Boulevard, you would have
22 higher levels, and higher levels in the Hadnot
23 Point tanks, you would have water pressure --

24 **MR. HARDING:** For any sustained operation
25 eventually you'll get to the point where the

1 flow is coming back through the valve. I
2 can't imagine any other --

3 **DR. GRAYMAN:** Except when they turned off
4 the Holcomb Boulevard treatment plant which is
5 what they did right there in this case.

6 **MR. HARDING:** If there was an enormous
7 demand, that's right. But your model will
8 tell you this. The model will answer this
9 question pretty well.

10 **MR. SAUTNER:** And to answer your initial
11 question, logbooks indicate that the bypass
12 valve was open. They never mention anything
13 about the booster pump during this nine-day
14 period. Typically, logbooks were pretty
15 consistent and had good information on what
16 was open and what was closed. However, during
17 this nine-day period it does not indicate
18 whether the booster pump's on. I can run
19 different scenarios for both open, just the
20 bypass valve open, you know, see how it
21 reacts.

22 **MR. HARDING:** It should be fairly clear
23 because if your tanks are really, if your
24 heads are going down, if your grade's really
25 low, it would probably not be tolerated and so

1 they were probably running the booster pump,
2 and that seemed like that was their normal
3 mode of operation.

4 And where's the second, I found one of
5 the golf courses. Where are the two golf
6 courses? One was in Hospital Point --

7 **MR. ENSMINGER:** Both of them are there.

8 **MR. SAUTNER:** Both located in there.

9 **MR. HARDING:** Oh, okay.

10 **MR. ENSMINGER:** One's on one side of the
11 street, and the other one's on the other side.

12 **MR. HARDING:** Okay, I didn't count the
13 holes.

14 **MR. SAUTNER:** So as far as the
15 interconnections, from the Camp Lejeune
16 logbooks. We have information from 1978
17 through 1986. There are a few data gaps. You
18 can see here in '79 we have no information, in
19 '81, '82 we have no information.

20 The booster pump 742 operations, it's
21 a 700 gallon per minute rated capacity during
22 the study timeframe. That was later replaced
23 with a 300 gallon-per-minute pump, and it's
24 currently out of service. It was operated
25 mostly in late spring to early summer, April,

1 May, June, July, and it was operated more
2 frequently in the mid-'80s as you can see here
3 than it was in the early '70s.

4 I'm sorry, this is the number of days
5 that it was operated for each month. You can
6 see in the early '70s it was operated seven
7 days, one day, three days in 1980. And then
8 towards the middle '80s you can see it
9 operating a lot more.

10 **MR. ENSMINGER:** I have a question. What is
11 the, we understand that there was a valve
12 right there at Building 670, the Holcomb
13 Boulevard plant, that could be opened right
14 into the treated water in the water treatment
15 plant that was inter-tied to the Hadnot Point
16 system. And from the discussion I had with a
17 former water treatment plant operator, he said
18 they could transfer water from the Hadnot
19 Point system without running the booster pump
20 from the elevated tanks, just gravity flow.

21 **MR. SAUTNER:** I don't believe that there's a
22 --

23 Joe, you might be able to help me
24 answer this question.

25 -- I don't believe that there was an

1 interconnection directly to the Holcomb
2 Boulevard treated tank.

3 **MR. HARTSOE:** There's check valves in the ^
4 [Holcomb Boulevard -ed.] pump room that would
5 prevent it from going back to the treated
6 water reservoir. The only connection I know
7 that he's talking about would be the 12-inch
8 line coming from the booster pump. There was
9 a bypass --

10 **MR. SAUTNER:** But that doesn't run directly
11 to the treatment plant. It runs to the
12 intersection but not to the treatment plant.
13 It runs into the distribution system and not
14 directly to the treatment plant.

15 **MR. ENSMINGER:** Where was that valve that
16 opened and closed that 12-inch line?

17 **MR. HARTSOE:** Well, you had cut-off valves
18 between the booster pump and Holcomb
19 Boulevard, but if you have the valve shut off
20 in the booster pump itself, then the pump was
21 off. So there was no way to go back.
22 Somebody had to either go in there and open up
23 a valve inside the building itself and cut the
24 ^ [valve to -ed.] booster pump ^ [742 -ed.].

25 **MR. ENSMINGER:** Well, would it be possible

1 for somebody to take a short cut and leave
2 that valve open at the booster pump and just
3 shut the valve up at the plant off at the
4 intersection there?

5 **MR. HARTSOE:** We never messed with that
6 valve. I don't know of anybody messing with a
7 valve there. It would still have to go
8 through the pump, some way it would have to
9 gradually feed through the pump and --

10 **UNIDENTIFIED SPEAKER:** And the flow would be
11 so low that it probably wouldn't really make a
12 big difference ^, because that's the reason
13 why you have a booster pump that's to transfer
14 a large amount of water.

15 **MR. HARTSOE:** I don't know who would have
16 cut the valve, ^[on -ed.].

17 **MR. SAUTNER:** So the next graph is going to
18 be occurrences of the bypass valve openings,
19 the number of days. As far as the logbooks
20 are concerned, there's no openings all the way
21 until a first occurrence which was the nine-
22 day continuous opening on January of '85. And
23 then beyond that nine-day period it's opened
24 only a handful of times. One day here, four,
25 three and one day here.

1 This is kind of just an overall
2 summary graph of the hourly operation of
3 booster pump. It's a little difficult to see
4 on this scale since it goes from '78 all the
5 way through '87. It's zero hours to 24 hours,
6 and this is just simply when it was turned on
7 or when it was turned off. To zoom in and get
8 a little bit better of a picture this graph
9 right here to the right is May of '86, and you
10 can see this is the one that was used most
11 frequently. I think it was used about half
12 the amount of days of the month. And we
13 averaged, it was used from about nineteen
14 hundred hours to twenty-four hundred hours.

15 So we came up with some different
16 scenarios. As I said, it was operated most
17 frequently in May of '86. The hours of
18 operation according to the logbook are
19 nineteen hundred to 24 hours, and it operated
20 about half the days during the month, and that
21 was in May of '86. Then we also came up with
22 just a typical May of 1980 case. The average
23 hours that it was operated was seventeen
24 thirty through twenty-three forty-five, which
25 is about 5:30 p.m. to 11:45 p.m. And it

1 operated about three days during the month.
2 And we confirmed with Camp Lejeune former and
3 current water utility staff that they would
4 typically shut the valve off at twenty-four
5 hundred hours when the operator's shift was
6 over.

7 **MR. ENSMINGER:** You mean the pump.

8 **MR. SAUTNER:** What did I say?

9 **MR. ENSMINGER:** Valve.

10 **MR. SAUTNER:** Valve, yeah, sorry. Booster
11 pump 742. Sorry about that.

12 Just to refresh your memory on the
13 water distribution systems now. On the Hadnot
14 Point system, the treatment plant's right
15 here, the controlling tank down here. And
16 then we have the Holcomb Boulevard system with
17 the water treatment plant right here, the
18 controlling tank over here. Golf courses. We
19 have Berkeley Manor, which will become
20 important in terms of the historical
21 reconstruction simulations. Berkeley Manor is
22 right here with an elevated tank right here.

23 And another important thing is to know
24 that the golf courses during this timeframe
25 were irrigated with potable water which is

1 what created the big demand on the water
2 distribution system. And we also have our two
3 interconnections, which is the Marston
4 Pavilion bypass valve, and the booster pump
5 742. So again, remember these are all
6 preliminary results, nothing's finalized.

7 We have our first scenario which is no
8 interconnection. This was done as the May
9 2004 extended period simulation so there'll be
10 no water transfer between Hadnot Point and
11 Holcomb Boulevard. This is controlling tank
12 S-2323, which is the Holcomb Boulevard
13 controlling tank. And you can just see
14 extended period simulation simply fluctuates
15 all the way out 744 hours, which is 31 days.

16 Now, we did some interconnection
17 scenarios. This is May of '86 where it's open
18 every other day. The booster pump was pumping
19 every other day, nineteen hundred to twenty-
20 four hundred hours, and you can see it cycling
21 every other day. And we also have our third
22 scenario which is May of 1980 which is the
23 green line. And you can see fluctuation three
24 days in the middle of the month which is when
25 we planned it to operate.

1 So now our concentrations in the
2 controlling tank for Holcomb Boulevard, no
3 interconnection, there's obviously no transfer
4 of water from Hadnot Point to Holcomb
5 Boulevard. But it was open every other day in
6 May of 1986, there was still no transfer of
7 water to the controlling tank. And then
8 obviously if it was only three days, there was
9 no transfer of water. So no concentration was
10 making it to the controlling tank in Holcomb
11 Boulevard from the Hadnot Point water
12 distribution system.

13 Now however, if you look at Berkeley
14 Manor tank with no interconnections you can
15 see the water level fluctuating. With the
16 interconnection open every other day in May of
17 '86 you can see it fluctuate every other day.
18 And when it was open three days in the middle
19 of the month, similarly just three days of
20 fluctuation right here.

21 When we look at the concentrations,
22 and this is assuming just 100 micrograms per
23 liter or 100, I guess it would be considered
24 units, just to get a percentage-wise, to get a
25 feel for how much water from Hadnot Point went

1 into Holcomb Boulevard, with no
2 interconnection no water transfer, zero
3 concentration.

4 With the interconnection every other
5 day you can see concentrations build up in the
6 tank at Berkeley Manor. When it was open
7 three days in the middle of the month, the
8 green line, you can see the three steps in the
9 very middle of the month, and then there's no
10 more water transfer so the tank has
11 concentration in it and then you just see it
12 start to dilute out.

13 Interesting thing is, is that this is
14 for May of 1980. If you were to do, go ahead
15 and simulate June of 1980, you would have to
16 put this concentration in as a starting point.

17 Overall this is just a figure to look
18 at the distribution of the concentrations
19 throughout the systems. With no
20 interconnection all the water stays down in
21 Holcomb Boulevard -- I'm sorry, in Hadnot
22 Point. And there's zero water transferred
23 into the Holcomb Boulevard system. With the
24 interconnection -- again, these are all just
25 averaged out. So instead of running, well,

1 with running the extended period simulation,
2 instead of looking at over time, every value
3 was just averaged.

4 So with water connection in May of
5 1986 conditions, you can see no water in these
6 areas. Again, the yellow dots are zero-to-
7 five percent and the orange dots are five-to-
8 20 percent. So you can see on average in the
9 Berkeley Manor about, it actually comes to
10 about 22 percent water, well, 22 percent was
11 averaged in the tank. Overall the system it's
12 about 20 percent around these nodes.

13 And then with the three days in the
14 middle of the month when it was open in May of
15 1980, you see no water transferred in this
16 area. You see a few areas in here where
17 you're going to get between five and 20
18 percent of water from the Hadnot Point system.

19 So future considerations that we have
20 for this are to try and develop some
21 historical trends, explore using climatic data
22 which is directly related to when the golf
23 courses were irrigated along with the known
24 booster pump 742 operating conditions from
25 1978 to 1986 to try to estimate historical

1 booster pump operations from 1973 to 1977.
2 Remember, we don't need operations from '68 to
3 '72 because Holcomb Boulevard received all of
4 its water from Hadnot Point. So it was really
5 only a five-year period that we're missing
6 data right here on booster pump operations.

7 Some other considerations for
8 historical reconstructions, we have actual
9 data so instead of maybe doing an average
10 condition for May of '86 and saying that the
11 booster pump opened at nineteen hundred hours
12 and closed at twenty-four hundred hours, we
13 have the actual data on a daily basis and an
14 hourly basis of when the booster pump was open
15 and when it was closed. We could actually put
16 this into the model and still run it as an
17 extended period simulation.

18 We also want to run some scenarios
19 where I include Marston Pavilion bypass valve
20 opening into the historical reconstruction.
21 As I was discussing with Ben, I've run some
22 preliminary simulations. It appears that
23 there's little influence in the Holcomb
24 Boulevard area when the bypass valve is open.

25 And that's mainly because there's, I

1 guess it would be more influence in the Hadnot
2 Point area. Water kind of goes from Holcomb
3 Boulevard to Hadnot Point rather than going
4 from Hadnot Point to Holcomb Boulevard. This
5 can be changed also as we discussed with
6 varying tank levels to create different
7 pressure variants.

8 And also want to run the scenario
9 where the nine-day event from January 27th
10 through February 4th of 1985 with the bypass
11 valve open continuously. And with that I'll
12 leave it open to questions.

PANEL DISCUSSION: WATER-DISTRIBUTION SYSTEM

13 **MODELING**

14 **DR. DOUGHERTY:** Remind me about 1972 and why
15 there's no consideration in the second half of
16 1972.

17 **MR. SAUTNER:** In 1972 that is when --
18 correct me if I'm wrong -- isn't that when
19 Holcomb Boulevard, in June of '72, Morris?

20 **MR. MASLIA:** June of '72 is our best
21 estimate of when the Holcomb Boulevard water
22 treatment plant came online.

23 **DR. DOUGHERTY:** So the assumption is that --

24 **MR. SAUTNER:** Prior to '72 it was receiving
25 all of its water from Hadnot Point.

1 **DR. DOUGHERTY:** I understand, but there was
2 no interconnection you had to worry about
3 between the start up, which probably would be
4 ~~pre-transferred~~ [pre-transfer -ed.] to the
5 Department of Defense, and --

6 **MR. SAUTNER:** And so you're speaking the
7 actual June of 1972, July of '72. Yeah, I
8 suppose I could change that figure to be '72
9 through '77 and use, there would be no
10 transfer, well, it would be all Hadnot Point
11 water for April, May of '72. June/July we
12 might want to also find historical --

13 **DR. DOUGHERTY:** Right because it does
14 generate an additional exposure potential.

15 **MR. SAUTNER:** Correct.

16 **DR. POMMERENK:** Jason, for these very short-
17 term interconnections in your illustrations
18 here, you used 100 micrograms per liter as the
19 mass and as coming across the interconnection.
20 What are you planning on using for the
21 historical reconstruction? Are you going to
22 use the monthly mean that you get from your
23 groundwater model or, because, you know,
24 obviously these concentrations can change on a
25 daily basis in the system.

1 **MR. SAUTNER:** You're talking about
2 concentration input for the model?

3 **DR. POMMERENK:** Yes.

4 **MR. SAUTNER:** Well, we're not at that point
5 yet, but one way to do it is to whatever
6 number they get from the groundwater model,
7 whatever number they give me, I put it in as a
8 simple, we have a start, you know, they will
9 give me a date, a time when the concentration
10 was like that, and that will go into the model
11 as is.

12 **DR. POMMERENK:** Okay, but I want to caution
13 because we're going to have a monthly average
14 concentration. In reality, of course, the
15 concentrations can change on a daily basis.
16 And if you look at Table C-13, it nicely
17 illustrates how Building 20, which is the
18 Hadnot Point plant is 900 micrograms per liter
19 TCE, another day several days later 430 and
20 then another day later non-detect which means
21 within the distribution system there will be
22 also considerable fluctuation.

23 Now, I guess from an epi standpoint,
24 if you're using the mean that's fine for
25 Hadnot Point. But for the short-term

1 interconnection, you need to have some idea of
2 how much is going, how much mass is across
3 going across that interconnection during the
4 six hours or whatever that pump was on in
5 order to determine what the exposure will be
6 downstream. Because you cannot simply assume
7 it was mean concentration because it may have
8 been zero or may have been a thousand ^
9 [micrograms per liter during -ed.]
10 interconnection.

11 **MR. SAUTNER:** I don't think that there's any
12 way we can tell that though. I mean.

13 **DR. POMMERENK:** That's my point.

14 **MR. SAUTNER:** Well, it's going to end up
15 being an average. I understand that you're
16 talking about a short period interconnection.
17 We have what information we have. So I can
18 run different scenarios and --

19 **DR. POMMERENK:** Yeah, I mean, I think it's
20 going to be a stochastic problem though. Of
21 course, you don't know but that's my question.
22 How are you going to approach this in terms of
23 uncertainty which is again what, I guess, the
24 epi study's looking for since you don't know
25 but you need to provide some kind of measure

1 of how certain is your, of your exposure
2 modeling results. How are you going to
3 account for the fact that it could have been
4 during the six hours of interconnection that
5 the source could have had non-detect or 2,000,
6 that's what I'm --

7 **MR. SAUTNER:** Yeah, I guess we'll cross that
8 bridge when we get to it and discuss more
9 later. That's probably a discussion for the
10 panel to help determine. Maybe we could run
11 some Monte Carlo simulations or --

12 **DR. GRAYMAN:** You're right in terms of
13 there's both stochasticity due to the source
14 term at the treatment plant plus a great deal
15 in terms of when the booster pumps were on.
16 And I think you do have to consider both of
17 them. But it's, I mean, the amount of
18 information you have in terms of exactly what
19 the source concentrations are going to be at
20 any given time, how they're varying around the
21 mean and also when the actual booster pump was
22 turned on and off, especially in this three
23 year period where you have no information.
24 You're really going to have to do it in a
25 probabilistic manner.

1 **DR. CLARK:** We had a question from the
2 audience back here I think.

3 **MR. HARTSOE:** Let me clarify something. I
4 may have to get back with you on some of it.
5 I was thinking about what Jerry said about a
6 valve. I was thinking about what Jerry was
7 saying about a valve at 670 cut on. And
8 during that timeframe when the reservoir was
9 contaminated with the gas leak, 670 was shut
10 down, but water was still supplied through
11 that 12-inch line.

12 Jerry is talking about to 670. I
13 mean, it was being delivered water to 670, but
14 670 was not pushing any water out because the
15 reservoir was cut off. The water would not go
16 back to the reservoir because of the check
17 valves on the high-lift pumps, and I'm
18 wondering if what they were talking about when
19 they say a valve, during that time when we put
20 the, when we were putting the reservoir back
21 online and having to fill it up and took all
22 sorts of tests after that to make sure the
23 water was good enough to drink before we sent
24 it out.

25 We did have times when they probably

1 had to backwash a filter. And there is a
2 valve on the outside of the reservoir that you
3 had to, you could cut on, and that would be
4 coming from Building 20. So that may be what
5 valve -- I'm not sure and I'll have to get
6 back with you. I could see where they would
7 open that valve just to backwash the filters.

8 **UNIDENTIFIED:** And that's what I recall as
9 well.

10 **MR. HARTSOE:** I mean, I can get back with
11 you --

12 **MR. SAUTNER:** We'll get together in the
13 future and discuss the --

14 **MR. HARTSOE:** And, Jerry, that may be, I
15 don't know of any other valve they could cut
16 on but that one. So I'll be glad to get back
17 with Jason on that.

18 **MR. ENSMINGER:** And this other question
19 about the contaminant levels when the booster
20 pump was running and whether what the
21 contaminant, the idea that you didn't really
22 know what the levels were of the
23 contamination. Well, we only have one test
24 that shows what those levels were, and that
25 was the split samples taken by the state which

1 I gave all of you in your packet of documents
2 there. The analytical results showed the
3 levels in the Holcomb Boulevard system.

4 **DR. CLARK:** Dave, you had a comment.

5 **MR. ENSMINGER:** And that was one of them
6 that showed 1,148 parts per billion of TCE at
7 the Berkeley Manor housing area's elementary
8 school.

9 **DR. CLARK:** Dave, you had a comment?

10 **DR. DOUGHERTY:** It was just a question on,
11 and I'll reference Table C-13 kind of as an
12 example. Do we know the sampling protocol for
13 this 1985 data? These, just to get it right.

14 **MR. FAYE:** What was that question again?
15 I'm sorry.

16 **DR. DOUGHERTY:** Do we have a sample protocol
17 for the 1985 data from taps and those sorts of
18 things? In other words are these --

19 **MR. FAYE:** Protocol as to what?

20 **DR. DOUGHERTY:** The sampling protocols, how
21 the samples are actually taken.

22 **MR. FAYE:** No, but I suspect from earlier
23 information that in terms of the sampling,
24 which is not really that definitive, in late
25 1984 samples were collected in glass bottles,

1 iced and shipped to the laboratory.

2 **DR. DOUGHERTY:** How were they transmitted
3 into the bottle?

4 **MR. FAYE:** I think it was just you open up
5 the tap. You fill up the bottle.

6 **DR. CLARK:** You're thinking of the
7 volatilization issue I presume and the loss of
8 contaminant because of that sampling.

9 **MR. FAYE:** Oh, yeah.

10 **DR. DOUGHERTY:** I'm thinking of that and
11 then in terms of for using these as part of
12 the calibration targets that these may be
13 considered somewhat less than an actual --

14 **MR. FAYE:** Sure, and also I think the issue
15 that, the main issue is determining at the
16 beginning of this process, when Hadnot Point
17 was actually turned on to supply all of
18 Holcomb Boulevard, we don't really know what
19 the concentrations of the various, TCE for
20 example here, were at Hadnot Point at that
21 time.

22 But we know, number one -- well, first
23 of all, we know all the wells that were
24 pumping at this time. We know all but one of
25 the contaminated wells was turned off at this

1 time. And we do have concentrations in the
2 contaminated well at this time at the
3 beginning, which would be 651. So actually,
4 you could just do a simple mass balance. And
5 we know the pumping rates.

6 So we could just do a simple mass
7 balance and estimate what that source
8 concentration was at the beginning of this
9 intervention. So I don't really think that's
10 an insurmountable problem.

11 **DR. CLARK:** But I think you're correct. As
12 I recall at that time sampling was an issue
13 particularly for inexperienced utilities who
14 were just beginning to learn how to take
15 volatile samples of THMs and the VOCs as well.
16 It's a good point.

17 **MR. HARDING:** What's absolutely critical
18 about understanding the sample is the time of
19 day and the, really what's important, it's 100
20 feet from one of the tanks. I can't remember
21 the number, I think. Looking at it on Google
22 maps. Whether that tank's filling or emptying
23 has a profound impact on how you interpret the
24 sample.

25 If you remember Scott's little diagram

1 of how the plumes move, well, it happens the
2 same way in a water distribution system. I
3 mean, water flows downhill or down gradient,
4 however you want to think about it, but it
5 happens much faster. Your divide shifts can
6 happen in a matter of minutes, you know, the
7 switch from flow direction can change in a
8 matter of moments.

9 And so the exact moment you took this,
10 the snapshot of conditions at that moment
11 matters a lot. And we can't ever get that
12 exactly right, so you have to keep that in
13 mind when you're trying to calibrate a water -
14 - you have way more measurements out in the
15 system than I have ever had. I've got the
16 luxury of maybe two or three samples out in
17 the system most of the time. You've got this
18 wonderful fluoride calibration stuff.

19 I mean, you should be able to do a
20 pretty good job of getting a model that's
21 reasonable. You shouldn't try to fit it
22 perfectly because -- I'm going to talk about
23 this a little bit later -- you're over-fitting
24 your water demands right now, and we have to
25 back off from that.

1 But what I wanted to do was address
2 Peter's comments about the variability, and in
3 part it's this how incredibly dynamic a water
4 distribution system is, and how you could have
5 a sample at 8:00 a.m. and a sample at 2:00
6 p.m., and they could be completely different
7 depending on which source happened to be
8 supplying that node.

9 But just thinking out loud
10 conceptually what you need to do is you need
11 to have a, you're going to have a groundwater
12 model that gives you wellhead concentrations.
13 This is a term I use. This is that average,
14 vertically average, concentration on a monthly
15 basis. And then you have to have a model of
16 your well dispatch -- I've talked about this
17 several times -- that will bring the water
18 together into your unpressurized tank that
19 then is at the water treatment plant. And
20 this may or may not require a hydraulic model
21 because of the differences in head at the
22 different wells and the pump curves. You have
23 to decide that.

24 And then you're going to have the rest
25 of your water distribution model which you've

1 seen. And you're going to have to model this
2 concentration all the way through. You're
3 going to have one model that's integrated
4 together and it'll have to be stochastic
5 because you don't know how they operated the
6 wells absolutely, and you're going to have to
7 make a model.

8 But you can inform that model with
9 standard operating procedures or human
10 tendencies. And we've done the same sort of
11 thing before, you just have to do your best,
12 but you have to recognize the uncertainty and
13 quantify it. So I don't know, Walter may want
14 to add to that.

15 **MR. MASLIA:** Ben, can I just clarify
16 something because what you've said is
17 absolutely correct, but we're not going to be
18 getting that complex. From the start we made
19 a decision not to model the actual transfers
20 of water within the distribution system or
21 from the different wells in other words. If
22 the wells mixed in a single tank we would get
23 that single concentration. If not, we would
24 take the concentration on the finished water
25 side of the treatment plant. Now, in this

1 particular, a case like in Table C-13, and I
2 agree with you, I mean, throughout all the
3 data we have, except for the data that we
4 collected, we have no time data. This is, if
5 you put that together with the fluoride data
6 that we gathered, I think we've got a very
7 rich set to calibrate and test to. In other
8 words so you've only got one well pumping
9 during this period, and that's 651.

10 **UNIDENTIFIED:** Only one contaminated well.

11 **MR. MASLIA:** Only one contaminated well
12 pumping. To me it would seem to be, to use
13 this if you want to either verify the
14 calibration that we already have based on our
15 current field data and then try to model this
16 and see what it would take in terms of either
17 well combinations or opening-closing valves to
18 try to duplicate this.

19 **MR. HARDING:** Just as a general comment, you
20 guys focus too much on calibration and not
21 enough on the practical question of how you're
22 going to go back and extrapolate out the
23 periods when you don't have enough
24 information. It's wonderful to get your model
25 to fit and then you violate Mary's first law.

1 But you have to think about how you're going
2 to get a realistic model, a reliable model
3 that goes back in time to 1972 and 1976 when
4 you're not going to have any information.

5 And that's why I'm saying, and which
6 well is on. I mean, obviously -- I can't
7 remember all the numbers, but 651 was the real
8 bad boy here, right? If 651 isn't on, no
9 problem, right? Well, let me step back and
10 say something about that in a second. But if
11 it's on, then you've got big problems.

12 Now, one of the things that Jason
13 illustrated up here is the reason why you have
14 to do really long-term, extended-period
15 simulation because that trace went off the end
16 of the month. And typically what we would do
17 is we would run a year at a time, continuous
18 simulations, and then we would initialize the
19 next year with our tank concentrations and
20 even our pipe volume, the mass that was in the
21 pipes, because the pipes can store a
22 substantial amount of water and contaminant.

23 And so you'll have a memory in those
24 tanks. It is the memory of the system, and
25 you really have to respect that. If the tank

1 at the school there was discharging at the
2 time you took that measurement, that means
3 your tank had a milligram per liter in it. If
4 it was filling it, and it was getting
5 initialized with a milligram per liter. So I
6 just want to make that point.

7 But you really have to think about how
8 you're going to go back and not worry so much
9 about getting a trace that looks really,
10 really nice. But figuring out how you're
11 going to get a realistic and reliable model
12 and go back.

13 **DR. HILL:** In order to do that, and in order
14 to get an analysis of uncertainty it would be
15 really nice to use the dataset you do have and
16 do cross-validation where you'd leave off the,
17 use your different, but instead of leave one
18 out, leave a whole period out. And then go
19 ahead and calibrate however you want to to
20 your one set, and then look to see how well
21 you do when you come back to the set that's
22 not included in your calibration.

23 And you're going to want to use, for
24 those periods you don't have information,
25 you're going to want to use the method that

1 gives you the best power in that cross-
2 validation test. And that cross-validation
3 test will give you a measure of how well you
4 do when you don't have data.

5 And that's your uncertainty analysis
6 so you don't go back and do Monte Carlo, you
7 actually have an evaluation of how well you do
8 when you don't have data for the period of
9 interest. So it'll probably be faster than
10 what you're doing now in terms of an
11 uncertainty analysis, and it will have a
12 better statistical background.

13 **DR. GRAYMAN:** I just had a comment on what
14 Ben said. First of all, I'd turn it around a
15 little bit. What I'd say is you're probably
16 in a much more fortunate situation in terms of
17 having a better intrinsic model of the
18 distribution system than is normally the case
19 in any of these. So what it's done is it's
20 reduced the uncertainty in that part of the
21 model, so that's good.

22 But then carrying on that's a starting
23 point. We still have all of this
24 probabilistic analysis has to be done for the
25 source concentration for the operations. In

1 terms of what Mary said, I'm a little
2 concerned, and I guess I don't fully
3 understand what information you have, what
4 water quality information you have in the
5 distribution system. It just seems to be very
6 anecdotal still.

7 And so anything where you did an
8 analysis, where you tried to calibrate the
9 model and match this, and I'm not talking
10 about today's --

11 **DR. HILL:** I wasn't talking about the
12 concentration data. I was talking about the
13 pumping schedules. In terms of your
14 concentration data, I mean, what was done at
15 Tarawa Terrace is to just throw all this raw
16 data at the groundwater model and say fit it,
17 when, if you looked at the data, there was
18 absolutely no, you weren't providing a
19 function that was consistent with the data.

20 Now, what the inconsistency was there
21 I don't know, but you need to think about the
22 concentration data in the context of some of
23 the things people have brought up. Because
24 it's pretty clear, I mean, things change so
25 much day-to-day, there's something going on

1 with the collection activity or, and I don't
2 know those processes enough, but this data
3 needs to be evaluated with that in mind first
4 and altered.

5 So if these are all biased low because
6 of processes you know occurred, there has to
7 be some adjustment to those. If you throw
8 this into the regression, it just tries, I
9 mean, the models just try to match it, so you
10 have to, that was one aspect that was
11 presented by Professor Aral yesterday is that
12 you need to really look at your data and try
13 to develop, figure out what trends, your
14 underlying trends, are involved there, not
15 just throw the raw data at the model.

16 **MR. HARDING:** Let's be very clear --

17 **DR. GRAYMAN:** When you say this data, let's
18 be very clear which data we're talking about.

19 **DR. HILL:** That was the concentration data I
20 was talking about.

21 **DR. GRAYMAN:** The concentration data in the
22 distribution system or from the sources?

23 **DR. HILL:** Well, I mean, you can calibrate
24 the groundwater model on both of those. I
25 think individual well data has been dealt with

1 more frequently, and in either period -- I
2 can't remember -- are there periods of time
3 when we have distribution, we have finished
4 water concentrations, and we don't have
5 individual well concentrations?

6 **MR. FAYE:** I can answer that. The data to
7 the best of my knowledge that we collected at
8 several intervals, May of '84 was one where we
9 were all out there, these were when we were
10 injecting various --

11 Go ahead, Walter.

12 **DR. GRAYMAN:** Two thousand and four.

13 **MR. FAYE:** I'm sorry, 2004, yeah. We were
14 all injecting the fluoride and some other,
15 calcium chloride, into the distribution
16 system. That was strictly an effort to
17 calibrate the distribution system models. And
18 then similar things were done for Holcomb
19 Boulevard and Tarawa Terrace.

20 Now, there was no interest in
21 collecting any well data at that time. There
22 was, to the best of our knowledge, there were
23 no contaminated wells active at that time. So
24 this was strictly an effort to collect data to
25 calibrate the water distribution system

1 models, EPANET 2.

2 Now, to the only data that we have
3 where a contaminated well or wells were
4 operating and where contaminant concentration
5 data were actually collected within the
6 distribution system. Those data are all
7 presented with respect to the distribution
8 system on Table C-13, which you have in front
9 of you now. The --

10 Excuse me, Mary, go ahead.

11 **DR. HILL:** I think that the issue is that if
12 you have concentration -- I was going to say,
13 if you have concentration data into the
14 individual wells, I would think it would be
15 better to use that even if at the same time
16 you have finished water concentrations. But
17 then I was thinking, well, maybe that's not
18 the case because of the, there are so many
19 contentious problems with the samples. Maybe
20 it's not a bad thing to have duplication.

21 **MR. FAYE:** Let me just finish my thought,
22 and then we can address what you're trying to
23 say I think.

24 The only time that we actually have
25 data coincident in time where contaminant

1 concentration data were collected within the
2 distribution system and when we have knowledge
3 of the contaminated well or a well or wells
4 being pumped, was for this nine- or ten-day
5 period in late January and early February of
6 1985.

7 And those data in terms of the
8 distribution system are presented on Table C-
9 13. And the contaminant data at the
10 individual wells are also in tables, well,
11 it'd be Table C-7, basically, just Table C-7.
12 And in terms of the actual WTP, that would be
13 on Table -- help me here, folks, if you looked
14 at it. That would be on Table C-11.

15 And we also have daily records of
16 which wells were being pumped during this time
17 and which were not so we can actually, but
18 there was only one contaminated well at the
19 time and that was HP-651. So whatever was
20 going on, the other wells that were pumping
21 were actually diluting HP-651. I mean,
22 whichever ones they were, they were not
23 contaminated or were very minimally
24 contaminated, you know, as far as detection
25 limits were concerned.

1 So those are the only data that we
2 have where well data and distribution data
3 were collected relatively simultaneously.

4 **DR. HILL:** And you don't have the pumping
5 schedule. They destroyed those records,
6 right?

7 **MR. FAYE:** Well, we know which wells were
8 pumped on a daily basis, and because of the
9 extreme conditions that existed at that time,
10 it wouldn't be unreasonable to assume that
11 those wells were just pumping 24 hours a day.
12 They had to get the water into the system to
13 maintain, to supply demand. So if those
14 wells, you know, I think that would be a
15 reasonable assumption.

16 **DR. HILL:** If you really, I mean, given that
17 two-week period of time where you have this,
18 you have measured concentrations at the wells,
19 delivered concentrations, pretty good
20 knowledge of the flow system, so you could use
21 that as a test period, a really good test
22 period for your entire system of modeling.

23 **MR. FAYE:** Yeah, to demonstrate the validity
24 of the accuracy, precision, all the other
25 terms that were used, we could demonstrate it

1 as a test for that particular period of time.

2 **MR. SAUTNER:** And, Bob, also just to note.
3 We have pumping schedules not just for that
4 ten-day period. We have, I believe it's for
5 two months, right around there, isn't it?
6 December, January and February.

7 **MR. FAYE:** Right. So the whole process, I
8 want to make a point again, the whole process
9 is highly simplified because of the
10 extraordinary condition that existed, that the
11 wells were going full bore, full out to meet
12 demand. We know the pumping rates at the
13 wells, and there was only one contaminated
14 well at the time that was pumping.

15 And that turned out to be one that was
16 a real mess in terms of contamination. So it
17 is sort of a fortunate situation where all
18 this information happened to be -- and it was
19 totally accidental as far as I can tell -- but
20 it just turned out that that was the case.

21 **UNIDENTIFIED:** What were those days?

22 **MR. FAYE:** Basically from about January 27
23 or so of 1985 to February 11th, 12th, 13th,
24 1985. Something along those lines.

25 **DR. GRAYMAN:** I think it would be extremely

1 useful to take that period and it's almost --
2 I'll call it an exercise, but that's a little
3 bit pejorative -- but that you go through the
4 exercise of seeing that the model can
5 realistically match what happened during that
6 one-month period. But unfortunately, it's
7 such an unusual period that I'm not sure
8 you're going to be able to gain much in terms
9 of using that to simulate the other periods.

10 So it's almost going to be, it's going
11 to be necessary that you be able to reasonably
12 match it, but I'm not sure that that's going
13 to be that useful in extending it for the rest
14 of the 15-year period or 12-year period.

15 **DR. HILL:** You could use it as a test
16 period, as a check period. Don't use it as
17 calibration and do daily time steps.

18 **DR. CLARK:** We have a question back here in
19 the audience.

20 **MR. PARTAIN:** Just an observation, on the
21 May 1982 Grainger Lab report, actually, not
22 the report is going to have that, but there
23 was a sample taken from a point within the
24 Hadnot Point distribution system. I believe
25 it was Hospital Point and came with a reading

1 of 1,400 parts per billion within the system.
2 Can that not be a snapshot of what was going
3 on in that system so you can compare it to
4 what you got in 1985?

5 So you've got two different points
6 separated by three years. One with a 1,400
7 parts per billion reading at the hospital and
8 then later on the January '85 testing within
9 Holcomb Boulevard, and you've got the school
10 at 1,100 parts per -- 1,148?

11 **DR. HILL:** You can. The thing about this
12 other situation is you have a pretty good
13 handle on every piece. You have the pumping,
14 the -- and that's what makes it so unusual.
15 So the one you're talking about I'm not sure
16 that it's a similar set of circumstances or
17 not. I mean, maybe there is. I don't know.

18 **MR. PARTAIN:** That was a ^ [water-quality -
19 ed.] sample that they were doing and the lab
20 technician took it upon himself to actually
21 quantify the levels, and he came up with a
22 1,400 part per billion reading for ^[TCE -
23 ed.].

24 **MR. ENSMINGER:** Yeah, and three years later
25 you get 1,148 parts per billion of TCE in

1 another sample, and it's about 300 parts per
2 billion less than the '82 sample. Well, you
3 had some other contributing wells that had
4 been already taken offline, but you still had
5 that one hot one online, 651.

6 **MR. PARTAIN:** And that same technician also
7 noted that they had, they did that sample,
8 went looking again, and it dropped off, and
9 then several months later the technician has a
10 conversation with the base supervisor chemist
11 and says, hey, the peaks are back and they're
12 high again, but it doesn't quantify ^.

13 **DR. CLARK:** We'll let Morris get a point in
14 here.

15 **MR. MASLIA:** No, I've got a question
16 actually for both the epi people and the water
17 modelers.

18 Since the case or the set of data as
19 has been pointed out for the January '85 date
20 seems to be our most complete in terms of all
21 parts of the supply and delivery system or
22 distribution system that we've got information
23 on, and we know one contaminated well, 651,
24 was pumping being diluted by other wells,
25 which we know were pumping going in there,

1 could we not use that from the epi side, would
2 you not consider that potentially a worst case
3 scenario?

4 **MR. HARDING:** How could that be the worst?
5 Oh, for Holcomb Boulevard.

6 **MR. MASLIA:** Did they pump all the
7 contaminated wells at the same time?

8 **MR. HARDING:** I couldn't even --

9 **MR. FAYE:** No, you wouldn't consider that in
10 terms of the groundwater pumping. You
11 wouldn't even come close to considering that
12 as a worst case scenario. Because you could
13 have a situation easily where 651 prior to
14 1984, 651 -- or July '84, actually -- 651,
15 602, 608, 634 -- what others, could all be
16 pumping at the same time, and they'd be
17 dumping contaminants into the Hadnot Point WTP
18 like there's no tomorrow, so that would be
19 more of a worst case than just one
20 contaminated well pumping.

21 **DR. DOUGHERTY:** The entire 1968 through '72
22 period which --

23 **MR. FAYE:** Yeah, from 19, yeah, and prior
24 to, actually, 651 came online in I think 1970,
25 but prior to that you certainly had a good

1 number of contaminated wells that existed,
2 pumping into Hadnot Point WTP and being
3 distributed through the Holcomb Boulevard pipe
4 system. So, no, I wouldn't --

5 **MR. ENSMINGER:** If you use just the January
6 samples that would not be, another reason it
7 wouldn't be your worst case is because all
8 your benzene contaminated wells were offline
9 by that point.

10 **MR. FAYE:** Oh, yeah, I mean, considering
11 your individual constituents, yeah. You can
12 go right down the line and be indicative of
13 that. I'd say this 1982 sample that was
14 brought up that's on Table C-11 at the
15 hospital, 5/27/82, 1,400 micrograms per liter
16 TCE, that -- I'm just kind of blowing smoke
17 here -- but probably 651 was pumping then.

18 We don't really know, but that
19 concentration is comparable to some of the
20 January '85 concentrations. So there might
21 have been a similar situation going on. But,
22 yeah, in terms of worst case we really don't
23 know, but I wouldn't say January of '85 was
24 the worst case, just my thought.

25 **MR. HARDING:** You need to know to be able to

1 make a statement like that, you need to know a
2 lot, and you'd need to know where the water
3 was coming from that was at -- I can't think
4 of the name of the point, but the school.

5 **MR. FAYE:** Berkeley Manor.

6 **MR. HARDING:** You'd have to know, and it
7 could be coming out of the tank. It could be
8 a blend. And it's really hard to know. At
9 Hospital Point it's going to be a little more
10 stable I would think because it's sort of out
11 on the --

12 **MR. FAYE:** Out at the end of the
13 distribution system.

14 **MR. HARDING:** And I can't see well enough to
15 see if there's a tank between it and the water
16 treatment plant.

17 **MR. SAUTNER:** There is because here's
18 Berkeley tank right here.

19 **MR. HARDING:** I'm color blind too so I can't
20 see the pointer. So anyway, you can't make a
21 blanket statement like that. This is why you
22 build the model is to make this evaluation.
23 And you have to -- I want to make a little
24 editorial comment here -- you have to
25 comfortable going out on a limb and making

1 some subjective judgments about whether this
2 is a reasonable model or not. You're going to
3 have to do that because you just can't do
4 everything based on data analysis, as Mary
5 said. You're just going to have to test and
6 come out with, it's a great tool I think, but
7 you're just going to come out with something
8 that's over-fitted.

9 **DR. DOUGHERTY:** Just a quick question on
10 this early '85 data. So they have the
11 measurements at the treatment plant, and we
12 have measurements at wells, and we have
13 pumping rates.

14 **MR. FAYE:** Right.

15 **DR. DOUGHERTY:** Have you just done the
16 mixing calculation to see if the well
17 concentration and the treatment plant
18 concentration match?

19 **MR. FAYE:** No, as Morris hopefully clarified
20 earlier this morning, I mean, this work that
21 you all have in your notebooks here is very,
22 very preliminary work, very early in the
23 process of the project in terms of getting
24 some definitive results. So we just haven't
25 got to that point yet.

1 **DR. CLARK:** So there is a point, I think
2 Ben's got a good point. You could use the one
3 scenario to validate and calibrate the model
4 and then add in other wells as you think they
5 might have occurred during some of these
6 maximum contaminant mixing scenarios. You can
7 get a pretty good picture, I think, of what
8 might be going on within the system.

9 **MR. FAYE:** Absolutely. And whether we want
10 to use it as a sort of a test as Mary
11 suggested or as part of a full-blown
12 calibration, I mean, I think those points of
13 view just need to be worked out in a dialogue
14 amongst the staff and you folks and whatever.
15 But, yeah, it is the only time, it is the only
16 time where we actually can integrate the
17 complete system, pumping wells and their
18 respective models, the distribution system and
19 their respective models and then look at the
20 results.

21 **DR. DOUGHERTY:** I really encourage you to
22 take the ten minutes and do the calculation to
23 see if the mixing of the well data to the
24 treatment plant in that period of time is
25 self-consistent, and if not, it may give you

1 some sense of some response error and hence a
2 measurement error.

3 **MR. FAYE:** I agree, and it's neat because it
4 is a fairly simple thing to do.

5 **DR. CLARK:** But one thing I haven't heard
6 discussed is the potential for degradation.
7 Has any of that been factored into the
8 calculations at this point? We haven't really
9 done those simulations either, I know, but it
10 seems to me some of that could be important.

11 **MR. FAYE:** Absolutely. We know from Tarawa
12 Terrace as far as the groundwater's concerned
13 that probably degradation is a major issue.
14 Within the distribution system, that I don't
15 know.

16 **DR. CLARK:** Well, there's some pretty long
17 residence time in some of those tanks. I
18 haven't done the calculations, but if you're
19 given vinyl chloride as an endpoint then you
20 have a very serious issue.

21 **MR. FAYE:** Right, right.

22 **MR. HARDING:** I think the residence times
23 are ^[important -ed.].

24 **DR. CLARK:** It could be degradation also.
25 Well, like also, well, some of it may be

1 degradation within the system, but I don't
2 know. The times might be sufficient for
3 degradation.

4 **DR. KONIKOW:** Well worth looking at it, but
5 the residence time in the groundwater much,
6 much, much longer than the residence time in
7 the tank.

8 **MR. HARDING:** If this is a matter of triage
9 I wouldn't spend very much time on worrying
10 about degradation in the water treatment
11 system. You've got lots of other good stuff
12 you could spend time on here that's way more
13 important than that. Don't focus on the
14 details, focus on the big picture.

15 I want to ask some more questions
16 about water use, because water use, you have
17 continuity, and you have energy that balance
18 in these models, and some of us think in terms
19 of continuity, and some of us think in terms
20 of energy, and the systems are different,
21 sensitive in different ways. But in this
22 particular case where you've got this big old
23 golf course out there, and that's what's
24 driving some of these interconnections. You
25 know, understanding the pattern of water use

1 is going to be important.

2 And I'm concerned that I haven't heard
3 enough, I don't quite understand exactly what
4 you've done during your calibration period,
5 but more than that I don't understand your
6 plan for going back and modeling this during
7 the periods for which there are no data. And
8 the way I've approached it, and I think
9 Walter's done it the same way.

10 We first sort of load the nodes with a
11 kind of a fraction of the water use on a daily
12 basis. And then apply a unit-less pattern of
13 diurnal water use. I'm sort of getting the
14 sense that what you've done is you've fitted
15 both the total daily water demand and the
16 diurnal pattern, using PEST, and again, it
17 makes a beautiful chart, but it isn't going to
18 help you when you go back in time. I don't
19 know if you have daily records of water
20 production at the water treatment plant, do
21 you?

22 **MR. SAUTNER:** Daily? Daily records?

23 **MR. FAYE:** Yeah, we do have daily records I
24 think in terms of production. That was on one
25 of my slides the other day, yesterday.

1 What is it, Jason, 2004 to 2008 and
2 then there's '95 through --

3 **MR. HARDING:** No, I meant back in the time
4 that matters.

5 **MR. FAYE:** No.

6 **MR. HARDING:** So you're going to have to
7 come up with a pattern of use on a total
8 system use and then you're going to have to
9 disaggregate that to the nodes spatially. And
10 then you have to disaggregate it with your
11 diurnal pattern. And so those are some of the
12 conceptual steps. I mean, you can throw up
13 your hands and say we can't do it, but I've
14 done it. Walter's done it. You have to do
15 it.

16 **DR. GRAYMAN:** I'm not clear. I think you
17 weren't sure either in terms of when PEST was
18 done. Was it done just to give you these
19 representative eight diurnal, say, normalized
20 patterns? Or was it also to try to determine
21 the quantity of water that was used, say, over
22 that period?

23 **MR. SAUTNER:** No, I believe it was just done
24 for the diurnal.

25 **DR. GRAYMAN:** Yeah, that was my

1 understanding.

2 **MR. SAUTNER:** The quality, we used the water
3 conservation analysis study.

4 **MR. HARDING:** How does that get water to the
5 individual nodes? How do you know how much
6 water was used at or near the school in
7 Berkeley Manor, for example, just as an
8 example? How did you understand that from the
9 water balance?

10 **MR. SAUTNER:** Well, from the water
11 conservation study we had different categories
12 of demand, whether they were bachelor
13 housings, family housings, so we know Berkeley
14 Manor is a family housing area. Most of the
15 demand nodes in that area were assigned.

16 **DR. GRAYMAN:** Okay, so the equivalent of
17 having a meter, an annual meter.

18 **MR. HARDING:** That's good. That's good.

19 **DR. BAIR:** That's great, and I misunderstood
20 that because I thought you were fitting --

21 **MR. SAUTNER:** I'm sorry. I wasn't clear, I
22 guess.

23 **DR. BAIR:** No, that's the way, that's
24 conceptually the way it should be done. And
25 then but you're going to have to come up with

1 a set of patterns that are either constant or
2 respond to certain rules. For example, Mary
3 suggested doing it every day of the week.
4 It's probably not going to help you much, but
5 you definitely want to take into account
6 weekend days, for example.

7 On your golf course you know they're
8 not going to water the golf course at two
9 o'clock in the afternoon, right? You know
10 they're going to water it at night --

11 **MR. MASLIA:** Actually, that's not correct.
12 Ben, seriously, they water it when the general
13 calls up and says he wants to have a tee-time,
14 and then they turn it on.

15 **MR. SAUTNER:** We were told anywhere from
16 early morning to afternoon to late at night it
17 could have been watered.

18 **MR. ENSMINGER:** Having lived there I have
19 some resident knowledge of the water usage on
20 that base. Wallace Creek separates those two
21 areas right there. The Hadnot Point and
22 Holcomb Boulevard system -- that's Wallace
23 Creek. It separates, this is Hadnot Point.
24 This is the Holcomb Boulevard system. At
25 eighteen hundred every evening, the water

1 demand down in here where all the troops are
2 at would drop off dramatically.

3 **MR. PARTAIN:** The Officer's Club?

4 **MR. ENSMINGER:** No, no, the Officer's Club
5 was up here. It was up in here, right in
6 here. All these housing areas, Midway Park,
7 Berkeley Manor, Paradise Point, those demands
8 in the evenings would go up because the people
9 were coming home.

10 Now the troops, after we got off work
11 we had PT, and then we'd secure the troops.
12 They'd go back to the barracks and they'd
13 either, well, they'd get their showers, and
14 then they would put their civvies on and go to
15 chow hall or head out to town to the bars. So
16 the water demand over here would drop off.
17 Then in the morning about 0500, the water
18 demand here would start picking up again and
19 level out. You know you had morning PT,
20 showers, chow hall, formation, back to work,
21 and then you had that same cycle.

22 On the weekends, the weekends the
23 water demand here was low. On Hadnot Point
24 the water demand here would be high because
25 everybody would be home.

1 **DR. CLARK:** What about light industrial use
2 or lawn watering in residential areas?

3 **MR. ENSMINGER:** You didn't have many people
4 watering their lawns in base housing unless
5 you had a few people that were trying to get
6 yard of the month or something. I never did.
7 But industrial, most of your industrial, all
8 of your industrial use water would have been
9 at Hadnot Point.

10 **DR. GRAYMAN:** Right. I think one step you
11 want to take is take a look at those patterns
12 as you develop from a PEST modeling and really
13 to check them for being reasonable based on
14 what he was saying.

15 **MR. MASLIA:** We actually, if you go back
16 when we were, when we tested like the Hadnot
17 Point system and injected the calcium
18 chloride, you actually saw that exact diurnal
19 pattern. It jumped up at 5:00 or 6:00 a.m. in
20 the morning and then leveled off and then
21 Hadnot Point went down around four or six or
22 whatever. That we saw when we did the test.
23 And so I mean from that standpoint, the PEST
24 just confirmed that. It was just trying to
25 optimize the tank water level

1 **UNIDENTIFIED:** And the different patterns
2 for the different types of units.

3 **MR. MASLIA:** Yes, yes, that's correct.

4 **DR. HILL:** One thing on the, just thinking
5 about those patterns and looking at like one
6 of the figures -- it's Figure 8 in the text --
7 but this is, it's May 24th through May 28th.
8 That's a Monday through Friday. And if you
9 look at the different days, there's not,
10 Monday and Tuesday it looks like they're kind
11 of similar in pattern. But then the other
12 days look, Thursday and Friday look similar.
13 But to my mind there's not a lot of diurnal
14 similar patterns in this.

15 **MR. HARDING:** This is real life.

16 **DR. HILL:** Well, yeah, so I guess any
17 patterns we think about could be compared
18 against this data and that could be part of
19 what goes into the model testing.

20 **MR. HARDING:** Let me make a comment here
21 that you can't expect under normal sort of
22 modeling extrapolation conditions to be able
23 to predict what happened at 2:00 p.m. on
24 Tuesday, June 12th. You can't do that so you
25 have to average things after, you've got to

1 run these models on an hourly or shorter time
2 step because you don't get the dynamics of the
3 system. But then you've got to average things
4 up.

5 And your goal is to get good
6 statistics that support the epidemiology study
7 over these sort of windows of three months,
8 right? So you probably have a rolling average
9 of over three months because that's your
10 resolution need.

11 For these case studies where you've
12 got a critical case, like this case we're
13 talking about here at Berkeley Manor and maybe
14 the Hospital Point, yeah, that would be great
15 diagnostics to go down and just really detail
16 this down and lock everything down and see if
17 it's all consistent, but I wouldn't put too
18 much stock in it. You've got to set your
19 error bars. You've got to be comfortable with
20 the fact that you're going to have some error
21 bars in this.

22 **MR. SAUTNER:** I just want to add one thing
23 also for the calibration procedures. We had
24 other hydraulic information and we put some
25 water meters out to record flows. So we have

1 that as another calibration measure. We had -
2 - Walter was in with us when we conducted some
3 fire flow tests. So we do have shorter period
4 of times that we can go in and look at more
5 specifically for our calibration.

6 **MR. PARTAIN:** When we were talking about the
7 golf course, I did want to show you all this
8 memo here, and this is, if you look at the
9 date, July 1985. So this is post -- I'll put
10 quotes around it -- post discovery of the
11 contamination. And this is a memo from the
12 Base Maintenance Officer to the Assistant
13 Chief of Staff Facilities. If you look on
14 here, let's see, they currently have two 250
15 GPM booster pumps to provide pressure for the
16 pump and sprinklers on the north course. It's
17 one course.

18 **MR. ENSMINGER:** The whole course.

19 **MR. PARTAIN:** One course, which when
20 operating do draw a considerable amount of
21 water. We really need to pursue this. And
22 looking at the rounding slip, let's proceed
23 with vigor -- I can't read from here.

24 **MR. ENSMINGER:** Info from PWO.

25 **MR. PARTAIN:** Public Works Officer. Can you

1 read that for me, Jerry? I can't see that
2 from this side.

3 **MR. ENSMINGER:** When do you think we'll have
4 -- incorporated?

5 **MR. PARTAIN:** Information, and that's Mr.
6 Price, his comments.

7 **MR. ENSMINGER:** He was the head ^.

8 **MR. PARTAIN:** And then on the back, "Yeah,
9 thanks, Bill, this is good idea. We should
10 push hard." So the golf course is an issue
11 here. I mean, they're, yeah, this is
12 priority. They realize they've got to drain
13 the system. And keep in mind now we've got
14 wells offline. There's water problems.

15 We have documentation that there's
16 water issues at this point, and there's a
17 concern here. So the golf course evidently is
18 drawing a lot of water somewhere. And one
19 course, we've got two, basically, two 250
20 gallon pumps -- I'm sorry, two 250 gallon per
21 minute pumps pumping out and what kind of draw
22 is that going to put on the system.

23 **MR. ENSMINGER:** And this plan was actually
24 realized and initiated in 1987. They drilled
25 separate wells alongside of some of the water

1 hazards on the golf course. They were pulling
2 the water from the water hazard and
3 replenishing the water hazard with water from
4 the wells.

5 **DR. KONIKOW:** Would the recharge rate onto
6 the golf course be higher than everywhere
7 else? Was that in the groundwater flow model?

8 **MR. FAYE:** No, except for a couple of
9 isolated areas out there, Lenny, what we call
10 the Brewster Boulevard aquifer system is
11 essentially a sand pile with some disconnected
12 clays and lenzoidal clays in that system,
13 which we call the confining units, respective
14 confining units, but it's basically a sand
15 pile. So what you basically got is whatever
16 there's left over after ET goes, is
17 infiltrated probably. And the water table's
18 ten, 15-to-20 feet depending on the contours,
19 the land contours. So that's essentially
20 conceptually what I think is going on there.

21 **DR. BAIR:** Aren't you surcharging it with
22 the golf course irrigation water in addition
23 to the rainfall?

24 **MR. FAYE:** Yeah, that was the question that
25 he asked.

1 **DR. BAIR:** So is that area given more
2 recharge than other areas in the model?

3 **MR. FAYE:** Sure, well, like I said, there is
4 no model right now. The work that Jason
5 talked about yesterday is very preliminary,
6 and so that represents, what he was doing
7 represents a long-term, average condition.
8 For the transient model, yes, there would have
9 to be some higher rates of recharge for that
10 area.

11 **DR. DOUGHERTY:** (Off microphone;
12 indiscernible).

13 **MR. FAYE:** Yeah, yeah, and as somebody
14 mentioned yesterday, it actually might even be
15 what they call a SWAG, which is a Scientific
16 Wild Ass Guess.

17 **DR. BAIR:** I guess I have a bad idea that
18 I'd like to pass along. As we talk about golf
19 courses, I'm a golfer. I hate the trees, but
20 I think the trees might provide you with a
21 surrogate for some information you're looking
22 at on a longer average than what we've been
23 talking about on the water distribution
24 system.

25 But some types of trees take up TCE,

1 and if you were to core some of the trees on
2 the golf course in Berkeley Manor and other
3 places, I suspect you can find a laboratory
4 that could analyze the annual growth rings for
5 the amounts of TCE. Now, it won't tell you a
6 microgram per liter, but it will tell you a
7 high, low, none. And you could use that
8 timeframe as a surrogate for what's being
9 distributed across the base by looking at
10 different trees across the base. So that's my
11 bad idea.

12 **DR. GRAYMAN:** I was just going to comment
13 it's either brilliant or totally off the wall.

14 **DR. KONIKOW:** I'll go for off the wall.

15 **DR. GRAYMAN:** I think it's a good idea,
16 Scott. At least look at it.

17 **MR. ENSMINGER:** I saw that capability. I
18 saw exactly what he's talking about. They do
19 test and they can help.

20 **DR. GRAYMAN:** So what are the trees like on
21 the course.

22 **DR. BAIR:** Are there trees on the course?

23 **MR. ENSMINGER:** Oh, yeah.

24 **UNIDENTIFIED:** But they're not watering the
25 trees. They're watering the --

1 **MR. ENSMINGER:** Yeah, but those roots go way
2 down.

3 **DR. BAIR:** They're watering the fairways,
4 too, aren't they? They have to be.

5 **MR. FAYE:** Well, that's probably what we
6 need to do (off microphone).

7 **DR. BAIR:** Right, and then you could go to
8 the yard of the month and get tree rings from
9 that.

10 **MR. ENSMINGER:** Don't be cutting all the
11 trees down, Scott.

12 **DR. HILL:** You don't have to cut the tree
13 down. You just core it.

14 **DR. BOVE:** This is an interesting idea, but
15 aren't we talking about from '72 to '85, we're
16 talking about a few days a month during the
17 summer months. That's what we're talking
18 about. We're not talking -- and before '72,
19 yes, Hadnot Point is serving this area. But
20 after '72 we're talking about a few days in a
21 few months during the summer so I don't see
22 the point. Am I missing something?

23 **DR. HILL:** You're getting data for the
24 period you don't have any information on.

25 **MR. HARDING:** Yeah, I think the button is on

1 the golf course. I'm sorry, but I thought it
2 was a good idea for Hadnot Point in general,
3 and I forgot that the golf course was outside
4 of Hadnot Point probably because it was such a
5 small event it may not show up. But other,
6 it's an interesting idea for Hadnot Point.
7 The thing is is that sort of the anecdotal
8 evidence indicates there was a lot of TCE a
9 lot of times there probably in Hadnot Point
10 itself.

11 **DR. BAIR:** Anywhere there's an irrigation
12 system on the base. Are they keeping the
13 Headquarters' petunias nice?

14 **MR. PARTAIN:** There are sources of TCE
15 within Hadnot Point, too.

16 **MR. ENSMINGER:** I don't know that would find
17 anything that was a confounding factor.

18 **DR. BAIR:** It was just an idea. I mean, as
19 an academic it's my job to come up with
20 something that uses my time and other people
21 pay for it.

22 **MR. ENSMINGER:** But in the Hadnot Point
23 system I don't think you'd find anything that
24 had a constant irrigation in it.

25 **DR. GOVINDARAJU:** I just wanted to go back

1 to this question of calibration. So the test
2 that was conducted in 2004, was the purpose of
3 that test to back calculate the demand
4 pattern? Because that means there's an
5 expectation that that demand pattern is going
6 to be repetitive of what happened in '84.

7 **MR. SAUTNER:** I'm sorry. So this test right
8 here?

9 **DR. GOVINDARAJU:** Yes.

10 **MR. SAUTNER:** This was a test we did --
11 let's do this test here. We actually injected
12 fluoride and chloride into the systems. This
13 was to help us calibrate the model, and we
14 gathered different hydraulics on the system
15 and pressures and water levels, flows.

16 **DR. GOVINDARAJU:** True, but when you are
17 fitting, you are saying I will ~~assimilate~~
18 [simulate -ed.] by fitting let's say the
19 demand patterns or demand factors from test.
20 So it looks like the purpose of this test was
21 to basically get the demand patterns out. Was
22 that the goal of the test then?

23 **MR. SAUTNER:** Yeah, well, we did not have
24 demand patterns except for a water balance, so
25 we used the water conservation analysis to get

1 a general demand allocation.

2 **DR. DOUGHERTY:** So did you fit only the
3 water patterns or other parameters, too?

4 **MR. SAUTNER:** Well, we did other sensitivity
5 analysis. We tried to change pipe frictions
6 and stuff like that.

7 **DR. DOUGHERTY:** Tank mixing?

8 **MR. SAUTNER:** Tank mixing, yeah.

9 **DR. GOVINDARAJU:** So basically, my feeling
10 is that system parameters [^][including -ed.]
11 perhaps tank mixing and all, those have been
12 ~~formatted~~ [fitted -ed.] because with that you
13 can perhaps get an estimate of what the
14 friction factors were back in '84. The demand
15 pattern is going to be, even if you prepare it
16 very correctly with this, the chances of being
17 able to reproduce it for '84 are very
18 difficult. Already I think we have heard
19 about what you are going to get are monthly
20 averages which you have to somehow fractionate
21 or disaggregate into much smaller intervals.

22 **MR. MASLIA:** Can I make a couple of comments
23 to maybe hopefully clarify what we have and
24 what we did and why we did it? We came in
25 there in 2003 and there was, from a model

1 standpoint, a description of the distribution
2 system. There was no information available as
3 to daily demand patterns and things like that.

4 What we had, as I said previously, as
5 most military bases have done, they've got a
6 conservation study that was done. Not only
7 for Lejeune, the Air Force has done it. The
8 Army's done it at all their military bases.
9 The purpose of that really was to study on an
10 average basis the water use and see how they
11 might reduce or conserve water.

12 And so it identified different water
13 outlets, swimming pools, showers, latrines and
14 so on and so forth. That was really our --
15 and then we knew the volumes of the tanks
16 obviously. That was the only real, you know,
17 that type of information that we needed. And
18 when we summed up the water balance from the
19 conservation study, we were off -- I mean, I
20 say we, I mean taking the numbers from the
21 study, off by about 30 percent from if you
22 added up the storage in the tanks and the
23 stuff the wells were pumping and all that sort
24 of stuff. So there was a discrepancy in
25 information there.

1 So one of the purposes in conducting
2 the distribution system test was to see if, in
3 fact, we could account for this discrepancy
4 because we knew we would have to have a more
5 robust -- I won't use the word accurate --
6 description of the distribution system.

7 We also made the assumption, and I
8 believe it's still a correct assumption, is
9 that the distribution system, with the
10 exception of obviously separating off Holcomb
11 Boulevard from Hadnot Point, but the activity
12 patterns would have been the same whether the
13 troops were there when we were doing the test
14 or the troops were there in 1968 or whatever.
15 And as Jerry correctly pointed out and we did
16 in the test, they get up, run the shower at
17 6:00 a.m. or whatever and then it goes on in
18 the Hadnot Point area.

19 In doing the test or gathering the
20 data, we then were able to, as we had
21 suspected, were able to, through using PEST,
22 determine that the friction factors were
23 insensitive. The system, the changes to that
24 were basically insensitive. That left a
25 demand pattern and water levels that were

1 measured in the tanks through the SCADA
2 available. And so we adjusted the demand
3 patterns. In fact, we were able to match what
4 actually was flowing through the system based
5 on our measured data.

6 What was interesting also was at the
7 end of the test, and I believe, was that, that
8 may have been a Thursday or a Friday, as
9 troops left for the weekend or whatever,
10 because we got folks at the Hadnot Point to
11 flow the system, I think it was, what, 2,100
12 gallons per minute, something like that. They
13 came to us and asked if they'd cut that back
14 because they were spilling water out of the
15 controlling tank, French Creek tank was
16 spilling water because they were pumping it at
17 an average rate of what we had gone through
18 the data and figured that the average flow
19 was.

20 So he's correct. Over the weekend it
21 drops. But our entire concept was that from
22 average operational sense what we saw when we
23 were doing the field test, which is what our
24 goal was, that we could use that at any
25 typical period historically to provide input

1 to the epidemiological study. And hopefully,
2 that clears where we got initial information
3 from.

4 **DR. CLARK:** Was the pipe material ~~the same,~~
5 ~~had been~~ [-ed.] pretty much the same over the
6 years or was there a switch from, say, cast
7 iron to vinyl chloride at some point?

8 **MR. MASLIA:** Joe can probably give you a
9 better idea, but at least now when they
10 replace it they use PVC, don't you -- right,
11 when they replace it presently, they're
12 replacing it with PVC. But to give you an
13 example, Tarawa Terrace was basically the same
14 as it was, and it's got a mix of cast iron and
15 PVC currently.

16 And even though C factor was not very
17 sensitive, it was much more sensitive to PVC
18 than it was to cast iron. And I've got those
19 plots in Chapter I report under the water
20 distribution part or the sensitivity of the
21 water distribution system. It really was the
22 purpose of the test or our concept going in is
23 that there was, in terms of where the pipes
24 went and all that, it would be no significant
25 changes from the historical system.

1 And that's why we felt or why we
2 justified that we could go out and get some
3 field data. But it was basically what the
4 primary driving factor was this big
5 discrepancy of 30 percent between what the
6 water conservation study said summing it up
7 and what we knew presently was the volume that
8 they were, you know, having.

9 **MR. HARDING:** The water conservation claim
10 was summing it up from estimates of individual
11 either categories of use or -- I'm not alarmed
12 by a 30 percent difference then. Those are
13 the same number. You've got to think in
14 astronomical terms sometimes.

15 Yeah, I mean, if you had measurements
16 coming out of the water treatment plant, those
17 obviously would be your best piece of
18 information which you don't have.

19 **DR. KONIKOW:** You're talking about
20 historically, right?

21 **MR. HARDING:** Yeah, if you had the flow
22 meter and you had the daily records, those,
23 I've had cases like that, then that's great.
24 We've had situations where all we had were
25 monthly data. You don't even have that, but

1 you're going to make an assumption about your
2 stress periods, right?

3 And the assumptions you make should be
4 the best you can make. Then they should be
5 consistent with the water distribution model,
6 and then you're going to have to disaggregate
7 that down to a daily pattern. There's a
8 variety of ways to do that. You know, you
9 have to understand and be comfortable with
10 this, it's going to be wrong. But as Locke
11 said it will be useful. And that's the
12 comfort you have to have. You have to be
13 willing to be wrong but provide a useful piece
14 of information.

15 **MR. FAYE:** We do have monthly data back to,
16 into the 1950s and also into the '70s and '80s
17 and '90s. So we do have a lot of monthly data
18 to deal with.

19 **DR. GRAYMAN:** Can I broaden this a little
20 bit? We can bring it back, but looking at the
21 schedule where we're scheduled to talk about
22 distribution system really for the rest of the
23 morning, I think at some point the group
24 should be looking at a little more broadly and
25 that we really have by my count at least five

1 different areas we're trying to simulate what
2 we're going to be giving to the
3 epidemiologists.

4 We have to be looking at wellhead
5 concentrations, which we talked a lot about
6 yesterday in terms of the groundwater flow
7 models. We have to look at the well operation
8 scenarios. How were the various wells
9 combined at any given time. The
10 interconnection scenarios, how was the booster
11 pump operated and the Wallace Creek valve.
12 The water use demand scenarios, which we have
13 ideas from the present study, but these are
14 still a lot of unknown. And then there's a
15 system operation scenario and that's primarily
16 how did they operate the system not from the
17 wells but once from the treatment, when would
18 the treatment plant pumps come on, how were
19 the tanks operated.

20 And I think it would be useful as a
21 group to try to discuss how are we going to
22 bring all these together. I've heard the idea
23 of using Monte Carlo simulation or some kind
24 of partition hypercube, but we're talking
25 about a large number of scenarios in all these

1 different dimensions. And I hope we can at
2 least start addressing that at some point.

3 **DR. KONIKOW:** Well, I don't think the
4 epidemiologists want all of that information.
5 They want -- correct me if I'm wrong -- they
6 don't want to know the details of the
7 groundwater flow model or the details of the
8 groundwater transport model or even the
9 wellhead concentrations. They want to know
10 the outcome. What went through the
11 distribution system.

12 **DR. GRAYMAN:** No, exactly what gets
13 delivered to the customer.

14 **DR. KONIKOW:** Exactly.

15 **DR. GRAYMAN:** But all of those things bear
16 upon making that vital decision.

17 **DR. KONIKOW:** Exactly, yeah.

18 **DR. ASCHENGRAU:** Just to add to that, I
19 mean, to me there were lots of issues that
20 came up yesterday that are similar of this
21 sort, right, on the groundwater modeling. So
22 it has to go even further than that, and it's
23 just to me we would consider all those
24 sensitivity analyses. And so we would want to
25 know sort of the bounds of the estimates, the

1 monthly estimates, that we are trying to get.

2 **DR. KONIKOW:** Let me add that there were
3 quite a few, I think, important issues causing
4 uncertainty and error in what predictions
5 could be made that we didn't get to discuss
6 yesterday. I mean, it's really much more
7 complicated and uncertain than we even, we
8 just began to scratch the surface.

9 **DR. GRAYMAN:** Right, and what's complicated
10 here, when we were dealing with Tarawa
11 Terrace, we were at the point where we really
12 weren't that interested in the distribution
13 system because it wasn't one of the factors or
14 wasn't a primary factor or even a major factor
15 in contributing how much was delivered to the
16 customers. Here we're now having to,
17 everything that was said about Tarawa Terrace
18 and complicating it by the fact that Hadnot
19 Point and Holcomb Boulevard appear to be
20 significantly more complex situations. We
21 then have to overlay that with the water being
22 delivered to the customers primarily in this
23 interconnection phase.

24 **DR. HILL:** This is actually just going back
25 to something that Bob mentioned earlier, and

1 it's coming back to the groundwater model
2 study. I apologize for that. But the idea of
3 this is just a pile of sand, I would like to
4 back off from that a little bit.

5 From the Castle Hayne downward it's
6 been there for 20 million years, and it's a
7 deposit that has some structure to it and some
8 information that we can take advantage of.
9 And the idea of representing, thinking of it
10 as just a pile of sand, I'd kind of like to
11 back off, thanks.

12 **DR. KONIKOW:** Maybe it was mentioned, it
13 probably was and I just forgot, but what is
14 the present situation at Camp Lejeune? Where
15 is the present water supply coming from? And
16 on a related issue, were the wells that were
17 shut off and abandoned, how were those
18 plugged? How were those sealed? Did we, was
19 the annulus ~~crowded~~ [grouted -ed.]? So really
20 two separate questions: one, what's going on
21 there today for the water supply? And second,
22 what was done with the abandoned wells?

23 **MR. FAYE:** There are some slides showing the
24 well locations, the historical wells and the
25 modern wells. I'm not sure if Jason has any

1 handy there or we can flip something up. But
2 the well, the modern wells, the modern, active
3 wells, Lenny, have been distributed along
4 Brewster Boulevard and then through the, sort
5 of the eastern extension of Brewster Boulevard
6 and down North Carolina Highway 24. So
7 they're well north of -- we'll see here
8 hopefully in a minute. You can look on the
9 posters as well. Just a second. And down
10 Sneeds Ferry Road, and these are all well away
11 from points of known contamination and indeed
12 the sampling indicates that there's no
13 additional contamination happening. Here we
14 go.

15 **MR. ENSMINGER:** Unless it's munitions.

16 **MR. FAYE:** There you go. Lenny, these are
17 the modern wells right through here in this
18 area and then down here, down Sneeds Ferry
19 Road down in this area. These are the modern
20 wells.

21 **DR. KONIKOW:** Aren't those down gradient?
22 If you look at the head distribution, isn't
23 that down gradient from the contamination?

24 **MR. FAYE:** Sure, but you're looking at a
25 relatively small radius of influence here for

1 most of these modern wells out here. There's
2 not any influence in terms of contamination
3 unless there's an unknown source out there.

4 **DR. KONIKOW:** Well, what's the slope
5 direction?

6 **MR. FAYE:** Pardon me?

7 **MR. HARDING:** Yeah, I'd like to see a head
8 map, I guess for the side gradient.

9 **MR. ENSMINGER:** It flows toward the New
10 River.

11 **MR. FAYE:** What's your question in terms of
12 the regional flow patterns? They would be
13 toward the streams, Wallace Creek and then
14 toward the New River.

15 **DR. KONIKOW:** Well, it certainly isn't
16 shallow, but as you go deeper is there -- in
17 the upper Castle Hayne, is the flow direction
18 the same as in the shallow system?

19 **MR. FAYE:** Pretty much, yeah, left
20 undisturbed by pumping wells, yeah, it would
21 be very, very similar, very similar, just like
22 Tarawa Terrace actually. That goes back to my
23 comment that Mary objected to that it's kind
24 of a big sand pile out there. You see very
25 little head difference.

1 Actually, there's some -- and this is
2 discussed in one of the Tarawa, I think
3 Chapter C, Tarawa Terrace report. There's an
4 excellent set of observation wells out here
5 from the lower Castle Hayne aquifer all the
6 way up to the Brewster Boulevard aquifer.
7 This is observation well clusters by the North
8 Carolina folks, the State folks.

9 I think there's maybe like a three-
10 foot head difference between -- and this is
11 undisturbed -- three-foot head difference or
12 four-foot head difference between the lower
13 Castle Hayne aquifer and Tarawa Terrace
14 aquifer.

15 **DR. BAIR:** That's huge. That's enormous.

16 **DR. HILL:** That's up or down?

17 **MR. FAYE:** Well, of course, it's upward
18 because it's right next to Wallace Creek. You
19 have an upward flow pattern. So we have about
20 a four-foot head difference here.

21 **DR. BAIR:** Yeah, but that's an enormous head
22 difference. For a pile of sand you shouldn't
23 have any head difference.

24 **MR. FAYE:** I beg to differ. If you're by a
25 regional drain, I don't care whether you've

1 got a pile of sand or not. If you've got 300
2 feet of sediments or so, you're going to have
3 a vertical upward --

4 **DR. BAIR:** You won't have a vertical drain
5 without a head difference.

6 **MR. FAYE:** Pardon me?

7 **DR. BAIR:** It won't flow vertically unless
8 there is a head difference.

9 **MR. FAYE:** Well, if you have a highland area
10 here where you have recharge, and then you
11 have discharge down to your main drains, which
12 is the New River, Wallace Creek or whatever,
13 you're going to have a diffuse upward leakage
14 in the vicinity of the drains, and that's
15 going to be vertical.

16 **DR. DOUGHERTY:** It means that the best
17 technical data's a turning point.

18 **MR. FAYE:** Yeah, I mean, all you have to do
19 is look at what Hubbard [Hubbert -ed.] did
20 back in the middle '40s. You can look at what
21 Tete [Toth -ed.] said in '55. And you've got,
22 that's typical regional flow patterns.

23 **DR. HILL:** You've got three head maps in the
24 material that I have. One is in Report
25 Chapter B. It's on page B-30 and it's

1 estimated pre-development, and so this is
2 contour measured. But the points aren't on
3 here so I can't say what's controlling the
4 contours, but these are these contours.

5 Okay, then you have one in the
6 material we were sent in the notebooks. It's
7 Figure 1, page 8 under Tab 6 after the, in the
8 second section of that. And that's also
9 contoured measured. And then you also have
10 the contoured simulated values later in that
11 section if I can find it. And that's Figure
12 3.

13 In every one of these maps, the
14 contours next to the streams imply a
15 completely different hydraulic connection
16 between the groundwater system and the stream.
17 And that's true for the Northeast Creek and
18 the Wallace Creek. So I mean, you're talking
19 now about that the three-foot head difference
20 and what that means in terms of
21 interconnection with the stream.

22 And really, without the groundwater
23 flow model, I don't know. I don't know if
24 what you're saying is correct or not. But I
25 can say that your potentiometric surfaces in

1 these three figures imply, each of them
2 implies, I mean, there are some similarities,
3 but there's some drastic differences.

4 And I don't know if you have these in
5 front of you. We haven't seen them in any of
6 the slides, but the one from B-30, the Tarawa
7 Terrace report, but that figure goes down into
8 part of Holcomb Point.

9 **MR. FAYE:** If you look in Chapter C of the
10 Tarawa Terrace reports, there's a discussion
11 in there of the simulated potentiometric
12 surfaces, and you can't quite see the upland
13 areas of Tarawa Terrace here, but they would
14 be here. Where you have recharge in the
15 upland areas in layer one.

16 **DR. HILL:** I'm not talking about that.
17 These are really dramatic differences. I
18 mean, it didn't come up yesterday and I don't
19 have slides, but in Chapter B the Northeast
20 Creek shows that it's highly gaining like
21 this. The contours look like this indicating
22 water coming into the stream.

23 **MR. FAYE:** Right.

24 **DR. HILL:** But the contours on Figure 1 that
25 we were given show the contour is going

1 directly across the stream like this as if the
2 water was really just going --

3 **MR. FAYE:** No, that's a boundary for --
4 well, it may be true, but what I'm saying --

5 **DR. CLARK:** Is this something we might want
6 to take up after the break?

7 **DR. HILL:** Yeah, that's fine.

8 **MR. WILLIAMS:** The wells, there's a State
9 standard for ^ [abandoning -ed.] wells [; -ed]
10 fill them with generally with bentonite and so
11 that there won't be an interconnection between
12 the possible transportation of contaminants
13 between layers. So we did abandon those wells
14 according to the State standards.

15 **DR. DOUGHERTY:** That's really not very
16 definitive because it doesn't say that you,
17 because there are various stages of
18 abandonment. One of them is simply pulling
19 the pump and leaving it in reserve. Another
20 one is filling the existing casing with
21 bentonite cement, and another one is yanking
22 the casing and actually making sure you've
23 grouted the entire annulus because we had, I
24 think we have well water records that say that
25 the annulus is open. So if you just filled up

1 the casing, which I don't know North Carolina
2 State standards so please tell me. Did y'all
3 yank the casing or --

4 **MR. ASHTON:** No, we did not yank the casing.
5 And typically these are gravel-pack type
6 wells. And, no, we did not yank the casings.
7 Typically, how these wells are constructed is
8 about a 50-foot grout to prevent surface
9 influence. Then, of course, they go down
10 between 150 to, in some cases, we have some
11 wells that are 250, some that are even deeper
12 --

13 **DR. DOUGHERTY:** (Off microphone)

14 **MR. ASHTON:** Pardon me?

15 **DR. DOUGHERTY:** How were they installed
16 here?

17 **MR. WILLIAMS:** Oh, those were all rotary.

18 **MR. ASHTON:** Yes.

19 **DR. CLARK:** Why don't we take this up after
20 the break and give you a chance to get
21 together and talk about it?

22 **MR. WILLIAMS:** Yeah, and the other question
23 that was unanswered is what's the state of the
24 water system now. And we can take that up
25 whenever you want.

1 **DR. CLARK:** Why don't we address all this
2 after the break?

3 (Whereupon, a break was taken between 10:20
4 a.m. and 10:33 a.m.)

5 **DR. CLARK:** We're going to change the format
6 just a little bit and change the order a
7 little bit. I think that maybe we're not
8 giving ATSDR the kind of advice that they need
9 to continue on with their work.

10 So what I've asked Morris to do and
11 Frank to talk a little bit about what they
12 think they would do for the future and what
13 kind of advice and input they would like to
14 have from the panel. We've got you guys here,
15 an expert panel, tremendous input, tremendous
16 help, but I'm not sure they're getting the
17 kind of advice that ATSDR really needs to
18 continue on with their work.

19 So, Morris, why don't you go ahead?

20 **PANEL DISCUSSION: WATER-DISTRIBUTION SYSTEM**

21 **MODELING (RECOMMENDATIONS FROM THE PANEL)**

22 **MR. MASLIA:** What we would like to focus
23 really on is, and at the end of the day when
24 you make your recommendations, besides the
25 details is the big picture. Because what we
have to be able to do is go back, or if any of

1 our management is here, and also go back to
2 the Navy and say, yes, we're going to finish
3 in this timeframe or, no, here are the steps
4 we need to take to accomplish to provide the
5 epidemiologists with an estimate of exposure.

6 And to be able to do that I think we
7 need to step back or go back to the bigger
8 picture recognizing that the details are
9 important; however, what I've noticed is we
10 were, I thought, getting down to so much
11 detail that we lost sight of the big picture
12 in terms of the distribution of water
13 historically at Hadnot Point and Holcomb
14 Boulevard.

15 So I just put up, just real quickly
16 here, from 1941 when the system came online,
17 Hadnot Point supplied everything until Holcomb
18 Boulevard came online approximately in June of
19 '72. During that period you have one system,
20 and you have all the wells contaminated, non-
21 contaminated going into a water treatment
22 plant so we can go back to what we did at
23 Tarawa Terrace and use a simple mixing model.
24 So that takes the distribution system water
25 dynamics and water quality dynamics of a

1 distribution system out of the picture
2 completely, and we just have to concentrate
3 on, yes, important factors, but the well
4 cycling and from a groundwater standpoint.

5 From 6/72 when Holcomb Boulevard came
6 online to '87, from August through March
7 there's no indication that there are any
8 interconnection, the booster pump or the
9 Marston Pavilion valve was turned on. So
10 again, we still have simple mixing because the
11 wells are feeding into storage tanks,
12 combining into storage tanks. So again, that
13 takes the detailed water quality dynamics of a
14 distribution system out of the picture.

15 So that leaves us basically this time
16 period in here for April, May, June and July
17 with an interconnection issue a couple of days
18 during the month. So the question or the idea
19 would be can we use, can we come up with a
20 typical day, a typical day that we could say
21 during a typical day -- with bounds on it.

22 I mean, I'm not throwing out the
23 uncertainty, but with bounds on it that we
24 could then say during a typical day to the
25 epidemiologists, this is what the exposure

1 would be at different locations in the
2 distribution system given what data we have,
3 given that we have a two-week period where
4 we've got test data or sample data or whatever
5 when the line broke, given that we also have
6 field data that we collected in terms of
7 calibration or seeing that the system operated
8 realistically from a diurnal pattern. And
9 that's --

10 I guess, Frank, is that stating I
11 guess the big picture?

12 And that's what I'd like to throw out
13 to the panel here to see if we could focus the
14 discussion really on that so we can get,
15 hopefully, some direction as to how we should
16 proceed on that.

17 Frank.

18 **DR. BOVE:** The other big picture is can we
19 get monthly averages? Does that make sense
20 given the complexity of the situation? Can we
21 get quarterly, should we move to a quarterly
22 situation where we get just quarterly data
23 averages? So that's another question that the
24 epidemiologists, I would like to know.

25 **DR. KONIKOW:** Doesn't that hinge also on how

1 well we do in predicting what the wellhead
2 concentrations were?

3 **MR. MASLIA:** Yes, absolutely, absolutely.

4 **MR. HARDING:** You can't model at those
5 longer time steps in the water distribution
6 system. You have to do it on an hourly basis
7 or a sub-hourly basis. The model will choose
8 the time period that it needs. But what you
9 can do then -- I'm thinking out loud here, but
10 Walter and I had a discussion in the hall
11 here.

12 What we've done in the past, because
13 as the water distribution people are always
14 the tail of the dog, and the groundwater
15 people deliver their stuff to us at the last
16 second, and then we have to make our
17 calculations. And so we adopted as a matter
18 of convenience, but it happens to be good in
19 other ways though, using the method of super-
20 position to provide a fast way to make the
21 calculations of nodal concentrations to the
22 concentrations of the source in use.

23 And we have -- my brain isn't
24 completely functioning here, so correct me if
25 I'm wrong. But we have two sources of water

1 at Holcomb Boulevard during the
2 interconnections. We have the Holcomb
3 Boulevard water treatment plan, and we have
4 one, possibly two, interconnections. I think
5 the second one is when the booster pump is
6 running is going to prove to be a drain, but
7 you could do the modeling during those actual
8 interconnection periods.

9 The hydraulic modeling will calculate,
10 just like Jason did up there, and use a
11 hundred part per billion or use the source of
12 water function in EPANET and calculate the
13 percentage of water from each source and each
14 node, average that over a rolling three-month
15 period, which is your resolution that you
16 needed, and will help avoid overconfidence in
17 what you're predicting because you're going to
18 be wrong on any particular day. You know
19 that.

20 But over an average of a period of
21 three months, and that's usually what I felt I
22 had some confidence in, you should be getting
23 close. And then keep those coefficients
24 there, and then you can do whatever you want.
25 You can load them however you want with what

1 comes out of the Hadnot Point mixing model.

2 **MR. MASLIA:** I'm in absolute agreement with
3 you. In fact, we took a similar approach, not
4 contaminant-specific, but in Toms River. In
5 other words put a hundred units in and did it
6 that way as well. And that's I think what I
7 was trying to hopefully get to here is to try
8 to simplify that in that --

9 **MR. HARDING:** And in the Hadnot Point system
10 the memory in the tanks is going to be
11 important if the wells, if the contamination's
12 going on and off. If it's more smooth ^ but
13 if you've got contamination going on and off,
14 then the memory of the wells becomes
15 significant.

16 But you can use the same approach.
17 You can use the, what we call transfer
18 coefficient super-position approach to run it
19 once, and then use it to force it with a Monte
20 Carlo or whatever you come out of a resampling
21 from your groundwater results, just thinking
22 out loud. Walter had some thoughts as well.

23 **DR. GRAYMAN:** You were talking about
24 temporal averaging period. Spatially, under
25 most circumstances we'll be able to say, well,

1 we can treat Hadnot Point as a single unit
2 just as we did Tarawa Terrace. Holcomb
3 Boulevard, hopefully, we may be able to just
4 do it by ~~assume~~ [assuming -ed.] Berkeley Manor
5 is homogeneous. And that can be tested in the
6 water distribution system model to see if
7 that's the case.

8 **DR. WARTENBERG:** I have a question about
9 this temporal averaging. One of the things
10 that would be helpful for an epidemiologic
11 analysis is to know the variability of your
12 predictions. And I don't know where in the
13 process you're doing the averaging and whether
14 or not it's possible to give us more fine
15 scale data that epidemiologists would average
16 using rolling averages or some other approach
17 or finally give us some sense of that.

18 **DR. GRAYMAN:** Finer scale temporally or --

19 **DR. WARTENBERG:** Temporally.

20 **DR. GRAYMAN:** -- probabilistically?

21 **MR. HARDING:** You can do it, but you have to
22 then use it in a longer timeframe because
23 you're going to be wrong. You're not going to
24 have it exactly the right time. But if you
25 want to calculate frequency information, I

1 think you could do it.

2 **DR. WARTENBERG:** Well, all I'm saying is if
3 you asked me what's the right temporal
4 increment? Should it be one month, three
5 months? I don't know the answer. But if you
6 gave me the data, say, daily data, then I can
7 average it different ways and look at it.

8 **MR. HARDING:** It scares me if you're going
9 to use it and on a daily basis.

10 **DR. WARTENBERG:** No, I wouldn't use it on a
11 daily basis, but I could look at how it
12 changes and aggregate it weekly, monthly.
13 Otherwise I don't see that variability.
14 That's what I'm saying.

15 **DR. KONIKOW:** Look at the first page of
16 Table C-7 that they handed out this morning
17 and look at the wellhead concentration in the
18 first well, 602, over a two-week period. It
19 hit a high of 1,600. The next sample is 540
20 and the next was 300.

21 **DR. WARTENBERG:** Those are still going to be
22 the data, right? Those are the data, and
23 you're going to have to --

24 **DR. KONIKOW:** You want to know what the
25 variability is on a less than a mean monthly,

1 well, there's the information we have.
2 Whatever we reconstruct in the model to feed
3 into the water treatment plant isn't going to
4 be any better than this. And this is your
5 sample, and you know, you say, well, there's
6 three samples in two weeks. What's the odds
7 of actually hitting a peak? Well, pretty
8 small. Somewhere close to this time it was
9 probably much higher than 1,600. There you
10 have an example of the range in a contaminated
11 well, and if you go to the really bad well,
12 651, you see similar things over basically a
13 two and a half week period it went from 3,200
14 to 18,000. Well, there's your sample of a
15 local area --

16 **DR. HILL:** And I really agree with that, but
17 the model's going to give you a very smooth
18 representation of what that system was doing.
19 The actual variability is just what Lenny
20 said. You've got it there, and that's the
21 best information you're going to get.

22 **MR. HARDING:** It won't be smooth in the
23 water distribution model. It will be step
24 functions. It'll be on and off. It won't be
25 smooth. But when you average it, you -- but

1 it will be wrong on Tuesday, or Wednesday.

2 **DR. DOUGHERTY:** Right, but if we do a
3 multiplicity of scenarios and then provide
4 those averages across the scenarios on a sub-
5 daily basis, which way do you want to, it just
6 becomes risky.

7 **DR. KONIKOW:** Well, there's no way in terms
8 of the wellhead concentration according to the
9 plan modeling scenarios, there is no way that
10 you could possibly reproduce the observed
11 variance in what gets fed to the water
12 treatment plant.

13 **MR. HARDING:** I can't even speak to what
14 gets fed to the water treatment plant. That's
15 your business not mine, but I'm saying that
16 what happens in the water distribution systems
17 is going to be way more dynamic. That's the
18 point I'm making. And let me just ask this
19 question about objectives here.

20 All the work that I've done in the
21 past, we've been looking at chronic effects,
22 and we haven't been looking at acute impacts.
23 And so what we looked at was what we called
24 either whole body dose or intake of a
25 particular contaminant, typically TCE, vinyl

1 chloride or chloride sometimes. And so you
2 would be looking at the accumulation by on an
3 annual basis.

4 And the reason that you looked at it
5 on a shorter basis was because people moved in
6 and out and things like that. Now, in this
7 case we've got to look at it on a shorter
8 basis because somebody, because we're worried
9 about these trimesters. But is it really
10 necessary to know that, or even useful to
11 know, that that occurred in the first month or
12 the third month? See what I'm saying?

13 Because I'm very, I think you're going
14 too far if you break this down more than a
15 quarterly basis, but you could do a rolling
16 three month summarization. And I'll leave it
17 to the statisticians to figure out just how
18 much structure you could put into that
19 summarization. Typically, we've used the
20 mean.

21 **DR. GRAYMAN:** Let me ask you a couple [of -
22 ed.] questions and interpret how you'd use the
23 information. Would it be different if you
24 were to get the information, let's say, on a
25 monthly basis or on a three-month basis that

1 the average concentration in the water was 300
2 micrograms per liter. If you had that
3 information, but if we were to tell you that
4 during that same period, the concentration
5 varied between zero and 1,500, would you use
6 that information? But on average it was 300.
7 Would that impact your study?

8 **DR. WARTENBERG:** I guess I don't know enough
9 about what people think the mechanism might be
10 in terms of how the causation works, but
11 there's certainly been studies where people
12 looked at maximum exposure levels or percent
13 of time above some level. In other words how
14 many days were they exposed above, and I don't
15 think there's good theory behind it.

16 What I was trying to get a sense of if
17 you're telling me the data are, I don't care
18 if they're not reliable for that day, but are
19 they really representative of the variability,
20 then that's useful. If they're not, then
21 obviously it's not useful.

22 But for things which people can
23 actually measure over time, sometimes people
24 have taken these daily numbers and then looked
25 at different ways of summarizing the exposure

1 not assuming that the average is what makes
2 sense.

3 **MR. HARDING:** I think that's okay. There's
4 some technical or mechanical issues that have
5 to be resolved. I mean, this is not going to
6 fall right out of EPANET as it comes off the
7 shelf and you pull the shrink wrap off it. So
8 there's some mechanical difficulties, but
9 that's why we pay Morris the big bucks and
10 Jason the big bucks, right? I'd be happy to
11 describe the way we've modified it, but, yes,
12 you can do that.

13 And you can basically -- leave to the
14 statisticians to figure out just which of
15 these things would be valid. But I would
16 think that days above a threshold would be
17 valid and a mean. The problem is that if you
18 don't do this right, you're going to have to
19 go back and re-run the model to get it again
20 with a different threshold.

21 So I would suggest figuring out a way
22 that you can run it on these short timeframes
23 and store your transfer coefficients on a
24 short period and then be able to run it
25 through a subsequent processing step to --

1 these are technical details, but I think it
2 can be done.

3 **DR. WARTENBERG:** Yeah, but I don't know if
4 Frank's thought about this at all. Just
5 listening to you talk about the different
6 timeframes just occurred to me.

7 **DR. BOVE:** When it comes to, say, neural
8 tube defects, we're talking about a time
9 window here of vulnerability of a few days
10 during the fourth week of gestation. We
11 can't, of course, know when those four days
12 occurred based on what the birth date of the
13 child or even if we have LMP, last menstrual
14 period, where a clinician decides on
15 gestational age. I'm not sure we could
16 pinpoint those four days anyway, or five days.
17 But that's how tiny the window is for neural
18 tube defects.

19 For clefts we're talking more of a
20 week or two, a two-week period for each of the
21 clefts, cleft lip and cleft palate. So we're
22 talking small timeframes of window of
23 vulnerability, but there's also uncertainty as
24 to when those two weeks occurred given what we
25 know about the child's birth and the mother's

1 LMP. So those are issues.

2 MR. HARDING: Well, I think the best you can
3 hope for would be this percentage of time
4 above certain thresholds, and I think that
5 would be a valid statistic to calculate. I'm
6 looking for support here from somebody that
7 knows more about this, but I think you can get
8 that, and then from that you could probably
9 make some inferences about what the odds would
10 be that this particular causative factor was a
11 factor in that particular.

12 DR. BOVE: Where are these thresholds coming
13 from?

14 MR. HARDING: Well, let's say that you'd say
15 that during this particular three-month period
16 the concentration was above 300 parts per
17 billion for sixty percent of the time or
18 something like that. And if your threshold
19 for impacts a hundred, I mean, we could do a
20 hundred, too. Maybe it's 100 percent of the
21 time. And so you've got a clear answer there.
22 It's going to be diceyer [dicier -ed.] if your
23 threshold is, say, 200 and the percent of time
24 above 200 is 30 percent. I don't know.

25 I can't answer that question for you,

1 but I think you need to step back. I wanted
2 to go back to Walter's point here. You need
3 to just climb up to about 20,000 feet for a
4 minute and look at this, and you guys need to
5 look and ask for your endpoint what you need,
6 and then talk about how you're going to try to
7 get the best estimates of those things you can
8 from the models.

9 **DR. GOVINDARAJU:** I'm seeing two kinds of
10 variability right now. First is if you have a
11 model run which has all these behavior
12 fluctuations and ^ [temporal -ed.]
13 fluctuations, if you want to average them or
14 do the moving window of let's say one week or
15 ten days or three months, then you'll get
16 fluctuations within one single model run.

17 But if you want to incorporate the
18 variability you're getting from wellhead
19 concentrations and so on, then you're talking
20 about doing many of these model runs to try
21 and capture that variability as well. So
22 there is almost like an internal, intra-model
23 variability, and somehow we have to combine
24 all this information to answer questions like
25 what is the likelihood that you will exceed a

1 certain value over a continuous ten-day
2 period.

3 Or what would be -- and so some of
4 those we can, I think those could be done, and
5 we could perhaps attach some probability of
6 what is the likelihood, what is the
7 probability of this kind of event happening.

8 **MR. HARDING:** In fact, what you're dealing
9 with in the water distribution system is
10 variability. And what Rao's talking about is
11 uncertainty, I think. And I would suggest
12 bringing Owen Hoffman who's a guy we've worked
13 with before on the, to help frame this team.
14 He's a really excellent person on risk out in
15 Oak Ridge. But, yeah, that's the issue.

16 You've got variability in the water
17 distribution system, which is more profound
18 than in the groundwater system, but just
19 happens faster a little bit. There's still
20 variability in the water distribution system,
21 and then there's a profound imperfection in
22 our state of knowledge about this, which is
23 the uncertainty we face. And that's going to
24 be represented by different iterations of a
25 Monte Carlo, for example.

1 **DR. HILL:** So we have this range of things
2 that epidemiologists might want. We have just
3 give me bulk, high, low, medium exposure or
4 no, medium and high exposure. And then we're
5 getting into these ideas of, well, if I had
6 more detail, this is how I would use it so
7 that I could use it.

8 And we've talked about different
9 strategies for creating more accurate
10 concentrations at the wellheads and whether or
11 not those are worth it and maybe they're not
12 worth it if you're just trying to get
13 rankings. But maybe they're well worth it if
14 you're trying to dig any deeper.

15 So it seems to me like there's a goal
16 of this groundwater model that's a bit of a
17 moving target as of these last couple of days.
18 And I'd be interested in, and I don't know
19 what you think about this, but it seems to me
20 like the design and effort in the groundwater
21 model depends very much on these priorities.

22 **DR. GOVINDARAJU:** The answer is yes, but
23 just to bring the discussion back, I think
24 we're talking about just the water
25 distribution system right now. Is that

1 correct?

2 **MR. HARDING:** I don't want to limit it to
3 that.

4 **DR. HILL:** It seems like the, it may be that
5 the water distribution system impact
6 dominates. I don't know, but I wouldn't think
7 entirely.

8 **DR. GRAYMAN:** I think it's time to broaden
9 this discussion back.

10 **MR. HARDING:** But certainly it only
11 dominates for, it may not even dominate, but
12 it's ^ [important -ed.] in this relatively
13 small piece of a relatively small piece
14 probably of Holcomb Boulevard. Unless the
15 wells are going on and off and there's big
16 step functions in the forcings [? -ed.] from
17 the contaminants, which I think is probably
18 unlikely, then the tank memory in Hadnot Point
19 will become important. But if it's not, it's
20 not important.

21 **DR. CLAPP:** I'd like to just respond to
22 Mary's laying out of the range of opinion
23 that's been made by us epidemiologists. I
24 sort of staked out the three-category thing
25 yesterday. But it's definitely true that the

1 more, especially for Frank's birth outcome
2 studies, the more detail the better.

3 I guess what I'm worried about is that
4 we're getting to a point where we publish an
5 effect estimate that has so much uncertainty
6 bound or bundled up in it that the confidence
7 bounds go off the page, and you're left with
8 just a big fuzz ball. So if we can narrow the
9 bounds of uncertainty to the point where it's
10 useful on a monthly basis, fabulous, and not
11 just a guessing game.

12 **MR. HARDING:** Don't expect -- I keep saying
13 this. Think in log space. Think in terms of
14 astronomical framework. I mean, when I've
15 done this before, the medical causation people
16 think that way. I mean, if the exponent
17 doesn't change, we don't have a significant
18 difference. I mean, you've got to be to that
19 point. I mean, you're talking -- we never did
20 get to the calibration standards, but you're
21 talking about a half an order of magnitude
22 plus or minus, so you've got an order of
23 magnitude range just in your calibration
24 standards. So how can you expect to be
25 conceptually better than that in --

1 **DR. HILL:** And that was heads.

2 **MR. HARDING:** Yeah. But I just think if you
3 can't use it for an epi study in the log
4 space, maybe you can't answer the
5 epidemiological question. But there's a lot
6 of other questions certainly that can be
7 answered or be thought about.

8 **DR. WARTENBERG:** I don't know if the ^ will
9 fix that or not but I mean, some epidemiology
10 has really ^ [had -ed.] horrible exposure data
11 and worked. There are countless occupational
12 studies where if you worked in a given
13 profession versus not, there are really clear
14 associations with disease.

15 And then it goes off in the other
16 extreme where people have very fine-scale,
17 accurate estimates of exposures and can show
18 associations. So in something like this where
19 I think it's less, there's less data to say
20 what the association is, it's a little hard to
21 say what we really need to show an association
22 if one exists.

23 **MR. HARDING:** But if I've learned anything
24 here, the one thing you want to avoid is
25 misclassification, right? So if we can get

1 that right, then we've made a step forward.

2 **DR. WARTENBERG:** Right, misclassification
3 will just blur the whole thing.

4 **DR. HILL:** So let me go back to -- it seemed
5 to me yesterday there were three ways to deal
6 with the wellhead, developing wellhead
7 estimates of concentration. One was just to
8 take the measured concentrations that we
9 already have. Say, okay, I'm going to project
10 back in space or in time that this really
11 contaminated well had some kind of average
12 value back, almost a step function or
13 exponential or something.

14 And just say, okay, based on
15 measurements here, I'm just going to project
16 it back. No physics, no nothing, just a
17 direct, and then feed it through the mixing
18 system of the well distribution system and get
19 exposed node, high-level node, whatever in
20 three categories.

21 That would be like level one. Level
22 two or level three, whatever, the other two
23 options that were discussed were doing some
24 linearization of the system and doing what
25 Professor Aral said. And then the third one

1 is to go through the whole groundwater model.

2 And so if this is level one, it seems
3 to me that then you want to think really
4 closely about, okay, if I can start with this
5 level, what do I want to get out of those next
6 two levels, and very specifically. Because I
7 think if you have very specific objectives on
8 what you want to attain from those given the
9 data you have and given what you have a hope
10 to, then you can make some progress.

11 But I'm a little concerned that the
12 charge being given for the groundwater model
13 isn't focused and defined enough, and it's
14 just like, well, just represent the system
15 accurately. Well, given this data what does
16 that mean? So I'd be interested in a
17 discussion that kind of address those three
18 things and what to get out of it.

19 **DR. ASCHENGRAU:** So I think with going
20 further would be to get a more accurate
21 ranking of those study subjects, that that's
22 what all of that effort would do would be to
23 boost at that accuracy and get a more accurate
24 ranking that would be possible with the first
25 method. So and it just seems as though

1 there's a huge amount of effort that needs to
2 take place in order to do that.

3 **DR. BOVE:** I think Mustafa's approach does
4 not take a whole lot of effort and may still
5 give us some of what we got for Tarawa
6 Terrace, if I'm not mistaken. So I think
7 that's the approach we've been thinking about
8 all along. That that approach might give us a
9 good answer, a good answer for the epi study.

10 And then if we need to move beyond
11 that, we could use that part, step two, to
12 help us with step three if we wanted to go to
13 step three. But we could try step two to try
14 to get the monthly averages like Tarawa
15 Terrace. And then if that was sufficient, we
16 could stop. Does that make any sense?

17 **MR. HARDING:** How do you know it's
18 sufficient?

19 **DR. BOVE:** We make a judgment. I mean, --

20 **MR. HARDING:** That's fair, but the concern I
21 have -- and I'm not a groundwater --

22 **DR. BOVE:** Not by -- we make a judgment
23 without looking at the outcome, blinded by the
24 outcome, of course.

25 **MR. HARDING:** Coming out of the world of

1 litigation I know there's a huge weight put on
2 trying to acceptance and I think that it's a
3 novel idea, and it seems to conform to Clark's
4 law about a sufficiently developed technology.
5 It really is cool what it does though I have a
6 problem thinking that people are going to
7 accept this very much when they can't get in
8 and dig around and look at the physical
9 underpinnings and say that these make sense.

10 Do the constraining layers, you know,
11 we've gone into all these details, and that's
12 a real pain for the modelers. And some people
13 focus on little details that are their
14 specialty, but on the other hand that's the
15 way you're going to develop confidence with
16 this is that does it look reasonable. And
17 unfortunately, you can't do that with a matrix
18 that's got 16 elements in it or 25 elements.

19 **DR. GRAYMAN:** Yeah, building on that, again
20 from the legal standpoint or at least my
21 observation of it, is a lot of reliance is on
22 has this model been used before. So if you go
23 in and you say I've used MODFLOW. MODFLOW's
24 been used for 25 years all over the world. It
25 develops a certain confidence. If you use

1 something else that's new and innovative, then
2 you, the burden of proof is on you that that
3 is valid. It's a tough thing to prove.

4 **DR. KONIKOW:** Well, in this case if you get
5 to the point of trying to develop a history of
6 wellhead concentrations using this full-blown
7 modeling approach, deterministic approach,
8 it's really going to be difficult to defend it
9 in a litigation requirement. I mean, there
10 are just so many weaknesses in assumptions and
11 uncertainties in it that it really will be
12 very difficult. I mean, you get very open to
13 attack.

14 **MR. HARDING:** It is, but it's been done many
15 times.

16 **DR. GRAYMAN:** Is it more so than other
17 situations? Is it more --

18 **DR. KONIKOW:** In this case more so than
19 other situations.

20 **MR. HARDING:** I've seen some really messy
21 situations with not nearly as much data.

22 **DR. DOUGHERTY:** But is it more than the
23 linear control approach?

24 **DR. KONIKOW:** Well, no, I think they both
25 hinge on what do we know. And what we know is

1 very limited. And so whichever, it's a
2 question of how do you want to extrapolate
3 back. For the wellhead what we really need to
4 know are two things. One is the pumping
5 history of each well. That's important to
6 know if the modeling will not give us a clue
7 about that. We have to tell the model what
8 that is, not the other way around. So that's
9 one thing that's needed.

10 The other thing is the concentration
11 in the well or in the well discharge, the
12 history of that. Now that we could try to get
13 that starting from a very deterministic
14 approach. And I'm not saying it's not worth
15 doing, but I'm saying we better have something
16 to compare it against such as Mary's level one
17 and just see how they compare. I think we
18 could do a little bit better and still keep it
19 very conceptually simple but key into the
20 history that we have even though as limited as
21 it is, those are the knowns.

22 And then there were all kinds of
23 questions about what causes this variability.
24 Look at the contaminated wells. It shows a
25 peak. You know, you've got five data points,

1 it goes up and then down. Well, is that
2 variance, is that just representative of a
3 saw-tooth pattern or was this the real peak in
4 the whole full-blown history.

5 But what I would say, and you will
6 have to reconstruct something about the mass
7 loading history to do the transport model, so
8 you will have some estimate of that
9 information. Well, take that information, use
10 your flow model in MODPATH analyses from each
11 well to each source and reconstruct the
12 distribution of travel times.

13 Use that then to lock in the starting
14 points in growth history of a concentration
15 curve, and then just bring it, just use a
16 thick pencil and bring it up, if you want to
17 work on a log scale exponentially or on an
18 arithmetic scale, try them both, then just
19 bring it up, use your MODPATH to get you a
20 starting point, an initial curve, and then
21 bring it up to your known history. And then
22 feed that into your mixing. Do that for each
23 well.

24 You still need as good a groundwater
25 flow model as possible, but you use MODPATH

1 instead of -- but then you'll still have other
2 complications. Do you want to retard the
3 movement field or retardation factor to catch,
4 but at least you have a starting point, and
5 it'll be much simpler and more defensible and
6 easier to explain conceptually than the full-
7 blown transport model. Do the transport model
8 also, but I think have this simple, I'll call
9 it level 1.5, as a way to get at the numbers
10 you really need and --

11 **DR. CLARK:** What about linear control?

12 **DR. KONIKOW:** I don't understand that well
13 enough to know that it's any different from
14 the drawing with a thick pencil.

15 **DR. CLARK:** Dr. Aral.

16 **DR. ARAL:** I think Mary wanted to say
17 something before I --

18 **DR. HILL:** Oh, no, all I had just wanted our
19 discussion to progress further before Dr. Aral
20 talked, but if this is the appropriate time
21 for that, that's fine.

22 **DR. CLARK:** That's an issue, I gather, is
23 how appropriate the use of linear control
24 theory would be.

25 **DR. KONIKOW:** If the linear control theory

1 is as good as it looked, then fine. Do it for
2 the wells where there's enough data to do
3 that, then great, but I don't understand about
4 the ^.

5 **DR. BAIR:** To me the shortcoming of it is
6 not in where it can be applied, it's where it
7 can't be applied. And do you go forward with
8 something that is an incomplete picture of the
9 whole thing from 20,000 feet, which would be
10 the linear control model at three or four
11 places, where you have sufficient data to go
12 forward with it.

13 Can you ignore -- I don't know -- 70
14 percent of the area or 60 percent of the other
15 production wells? And how do you enter that
16 missing 60, 50, 40 percent into the water
17 distribution model? And if you're missing 40
18 percent, how do you analyze that in an
19 epidemiological way when you're missing 40
20 percent of the possible source terms because
21 you didn't address all the wells in the flow
22 system?

23 **DR. KONIKOW:** Yeah, one of the things that
24 the transport model could do for you that the
25 data don't is that at least within the

1 framework of the conceptual understanding of
2 things, it may show you some surprises. It
3 may show you a pulse of contamination going by
4 one water supply well where you have no
5 records of contamination because it came and
6 went before the period of observation. So
7 things like this could be gleaned from this.
8 You just don't know whether to believe it or
9 not. You don't know what to do except to say,
10 well, there's a possibility.

11 **MR. FAYE:** Let me just say that Lenny has
12 pretty well articulated what we have discussed
13 in our planning conversations amongst the
14 staff. And in terms of the deterministic
15 model about the approach, the methods and how
16 to do it. And somewhere I hope there's a
17 verbatim transcript of that because it lays
18 out very well, as I said, what we have looked
19 forward to doing.

20 The issues with the linear model, the
21 difficulty there is what Dr. Bair talked about
22 is that you need concentration data at the
23 supply wells, and there's very little
24 concentration data for all of the abandoned
25 supply wells through time, and there is none.

1 And unless you have something going on at that
2 well that represents in the linear model,
3 there's no way to construct anything from that
4 in terms of a monthly concentration, quarterly
5 concentration, whatever.

6 **DR. HILL:** Okay, now I'm confused. Because
7 it seems to me that you have been advocating
8 the use of that approach, and now it seemed to
9 me that that was a very clear explanation of
10 why it was really pretty limited and so now
11 I'm confused.

12 **MR. FAYE:** Why are you confused? Because it
13 was totally presented yesterday as a screening
14 tool. I mean, well, it was, as I heard --

15 **DR. BAIR:** Twenty minutes ago it wasn't.

16 **MR. FAYE:** -- as I heard it was to be used
17 as a screening tool, as an adjunct to
18 developing our deterministic model.

19 **DR. HILL:** I have definitely been getting
20 mixed signals about how it would be used
21 exactly.

22 So, and Frank, some of your comments,
23 particularly made me think you were thinking
24 of it in a more, in a broader perspective. So
25 maybe you can --

1 **MR. MASLIA:** Let me clarify because we've
2 got some objectives here that need to be
3 mutually compatible. And that is that we need
4 to give the epidemiologists results that they
5 have some confidence in. And at the same time
6 we do not have an infinite amount of time or
7 resources. So what we need to try to do --
8 and I'm not necessarily talking about the
9 December date that we had thrown out. I'm
10 just saying in realistic, you know, we can't
11 go on for another five years like that.

12 With that said we were looking to
13 develop a screening-level method that could
14 initially give us some rough cut or estimate
15 to give us some handle on what the
16 concentrations would be back in time, and at
17 the same time, as Lenny and Bob said, perhaps
18 help us avoid from going to the full,
19 dispersive fate and transport approach and
20 using a much smaller sized advective transport
21 model.

22 **DR. GOVINDARAJU:** Well, I think one of the
23 things that we could consider is from what
24 Professor Aral explained yesterday, his method
25 is allowing us at least to have an idea of

1 what happened in the past for the wells that
2 we have observation. For wells that we have
3 observations recently, it can also reconstruct
4 some of the stuff in the past.

5 So we could use that information and
6 then have that also constrain the full-blown
7 groundwater model. Because the groundwater
8 model as it is has too many unknowns, too many
9 things that we aren't able to pin. So having
10 some other guidance to perhaps pin it at these
11 locations and for wells which have no data,
12 you're right, we have no data, let the
13 groundwater model, full-blown model, do its
14 best.

15 It'll already have a lot to do just
16 trying to capture that. So if it is outcome
17 guided in some other way with some other
18 information, I think we should use it.

19 **DR. DOUGHERTY:** Okay, I'm an engineer so I'm
20 trained to be conservative and have big safety
21 factors on things. So with that as a preface,
22 I'd like to move on. I'm in agreement with
23 Lenny in many respects here. I like the idea,
24 the linear control, the black-box model,
25 whatever you want to call it, I think it's

1 intriguing, and I think it should be explored
2 in parallel.

3 I think hanging your hat on it is
4 inappropriate because you're going get too
5 many hits once the first document goes out the
6 door. I do think it's very intriguing, and I
7 think it should be explored in parallel in
8 those locations where they are appropriate.

9 But I think we need to move past it
10 and get on with the other significant things
11 to deal with, which are the sources of
12 uncertainty that drive it, pumping schedules,
13 source locations and release times and mass
14 loadings and all the other things that we've
15 talked about.

16 **DR. HILL:** One thing that I'd be interested
17 in talking about is what groundwater transport
18 model to use. Because there's -- and I
19 brought this up in my comments as well --
20 there are widely used transport models that I
21 believe simulate the processes that are being
22 simulated, that are of concern for this model
23 and instead of a relatively, new untested
24 model that's being used. In this highly
25 political situation, I really wonder about

1 that decision.

2 **MR. MASLIA:** We used MODFLOW and MT3DMS.

3 **DR. HILL:** Yes, but for the reactive
4 transport.

5 **MR. MASLIA:** For the degradation, one of the
6 reasons we went there is we thought we might
7 need to get into the unsaturated zone.

8 **DR. DOUGHERTY:** So the plan here moving
9 forward is to stick with MT3DMS --

10 **MR. MASLIA:** Or MODFLOW/MODPATH.

11 **DR. DOUGHERTY:** Or MODFLOW/MODPATH.

12 **MR. MASLIA:** Yes, that is correct.

13 **DR. DOUGHERTY:** So we don't foresee the
14 unsaturated issue showing up here? I mean,
15 this because I have a hard time --

16 **MR. FAYE:** Actually, it could because
17 there's issues with vapor from PCE, BTEX into
18 the buildings, particularly at the HPIA. We
19 didn't really even anticipate a problem of
20 that nature with Tarawa Terrace. It did show
21 up with respect to one of the schools there,
22 and we had, it was a good thing that we had
23 the unsaturated zone model. So all I can say
24 is we just don't know, but it would be handy
25 to have because there are issues out there

1 where it would be useful.

2 **DR. DOUGHERTY:** So do you see that in this
3 particular study or other studies that are in
4 planning --

5 **MR. FAYE:** Well, as it happened in Tarawa
6 Terrace, it turned out to be a secondary
7 thing, a post-modeling thing, but it did
8 happen, and we did have the model there to
9 attempt to deal with it. And so who knows?
10 If the very same, as Mary said, this could be
11 a highly litigious situation, and it could
12 come up just right out of the blue as it did
13 at Tarawa Terrace.

14 **DR. KONIKOW:** Well, in terms of informing
15 the calculated wellhead concentrations, I'm
16 not sure I see the connection.

17 **MR. FAYE:** No, there is none. It would just
18 be an ability to simulate the unsaturated
19 condition.

20 **DR. KONIKOW:** So in terms of the objective
21 maybe that's going a bit astray then.

22 **MR. FAYE:** In terms of the objective as it's
23 stated now, yeah. I would agree with that.
24 But like I said, at Tarawa Terrace it was the
25 same issue. I mean, it was a kind of a

1 research thing to do. It worked out nicely,
2 and we did the whole degradation scheme with
3 it.

4 It happened to have an unsaturated
5 zone component. And from the point of view
6 though of doing the degradation, the complete
7 degradation pathways, Lenny, that was a model
8 that we used. It just happened to have an
9 unsaturated zone component that came in handy
10 later on.

11 **DR. KONIKOW:** Yesterday when we were talking
12 about the models we, I mean, we're kind of at
13 a disadvantage here projecting where the
14 transient flow model and MODPATH and the
15 MT3DMS will get us, we really never talked
16 about them, but you were having some
17 experience with Tarawa Terrace. And looking
18 at some of the documents in the three-ring
19 binder, there are still many -- maybe we need
20 a day or two, you know, eight months from now
21 to talk about this.

22 But I'm really particularly concerned
23 about projections of degrading calculations
24 of degradation rates or decay rates in there.
25 Because I saw preliminary estimates using

1 observed concentrations assuming that there's
2 no advection, no dispersion, no nothing else
3 going on and ignoring the fact that there were
4 remediation efforts going on, just using the
5 best fit to get a decay rate. And then saying
6 --

7 **MR. FAYE:** It wasn't even a best fit. It
8 was just two points at a time.

9 **DR. KONIKOW:** And then saying that that's
10 the rate you should use in the transport
11 model, and this is circular reasoning that I
12 think will be difficult to defend. So I mean,
13 there are many issues on the transport
14 modeling, and that's just one example that
15 really will leave the whole thing open to
16 severe criticism. I don't see any easier way
17 around it.

18 **DR. DOUGHERTY:** Those particular pages I,
19 those should be red-lined right now. Throw
20 them out. I'll be direct. They're terrible.

21 **MR. FAYE:** Which ones are you talking about?

22 **DR. DOUGHERTY:** The biodegradation reaction
23 section in -- I forget which tab it was under
24 -- there are two pages ^, and they're not
25 biodegradation or reaction fittings.

1 **DR. ARAL:** Morris, they have to log on.

2 **MR. FAYE:** All I can say is with respect to
3 that, Lenny, you're right. There's all kinds
4 of limitations. We have on the one hand, we
5 have a lot more opportunity because of data to
6 compute degradation rates in this study from
7 field data. But they're still limited by the
8 same caveats that you describe regardless.

9 And then the other choice is
10 literature data. All I can say is you know
11 we'll do the computation so we'll take the
12 field data out. We'll take the literature
13 data and look at it and make our best judgment
14 and defend it as well as we can. We know
15 that. We're aware of the limitations of using
16 those field data, for sure.

17 **DR. HILL:** Just coming back to the transport
18 model, having the capability to deal with the
19 unsaturated zone is fine, but usually to deal
20 with the unsaturated zone you need a fairly
21 fine grid. So you might consider using a very
22 fine grid, a much finer grid usually than you
23 need for the saturated zone. So you might
24 consider using the more sort of tested and
25 accepted model for some of your simulations

1 and bring in the model with the unsaturated
2 zone for those simulations that have that
3 requirement.

4 **MR. FAYE:** Yeah, I think that the point's
5 well taken. The application of that model
6 would only be with respect to what Rene was
7 talking about yesterday was the child models,
8 you know, where the --

9 **DR. HILL:** Right, I understand.

10 **MR. FAYE:** And that would be a very high
11 grid resolution.

12 **DR. HILL:** Let me just finish. I just
13 wanted to mention that the name of that model
14 is RT3D, which you know I'm sure.

15 **DR. CLARK:** Right.

16 **DR. ARAL:** I'm not going to defend any model
17 or any procedure. I'm just going to summarize
18 probably what has been said in this group this
19 morning.

20 As a technician in this field in
21 developing models and as a technician in this
22 field in applying models, we all know that the
23 model sophistication can be put forward in
24 terms of its ability to model this and that
25 and other things in the field that we observe

1 in any which way we want.

2 In other words technically we are
3 capable of developing a mathematical
4 representation of a physical system and then
5 computationally discretizing it and solving
6 it. We are technically capable of doing that.
7 And I'm summarizing that in this slide here.
8 This is one sophistication level that we can
9 look at. We can go beyond this. We can go
10 backwards from this. So model sophistication
11 from a technical point of view can go forward
12 from that in any direction that we would like
13 to go.

14 However, in an application the model
15 to be used should be a function of
16 availability of data in the field. We cannot
17 go to a more sophisticated model than that if
18 we don't have available data for the
19 parameters that we introduce at that
20 sophistication level because as we go forward
21 in sophistication, we are adding additional
22 parameters. If we don't know the parameters
23 then the uncertainty that we introduce into
24 the outcome is going to be greater than the
25 capability of the model to represent the

1 physical system.

2 So this is what has been discussed in
3 this group all morning. I mean, basically, we
4 have limited data. We have to accept that.
5 Can we go to a daily pattern in a water
6 distribution system? Yes, I have worked in
7 that. Yeah, I can put a daily pattern in.
8 But do we have that data? No. So the
9 discussion has to concentrate and focus on
10 what we have and what the model can do in that
11 arena.

12 The other aspect of all this in my
13 opinion, what is the outcome that we are
14 after? Yes, the data is limitation. The
15 model can be of any sophistication level, but
16 what do we want as an outcome? That is the
17 other consideration which is also discussed in
18 this group that we need to address. The
19 outcome is what the epi people want. Do they
20 want monthly data output of concentrations?
21 Do they want daily output or quarterly output?
22 So that needs to be a driver. All of this I
23 think has been discussed, and all I'm saying
24 is let's summarize that, and let's look at it
25 from that perspective.

1 The other concept that has been
2 discussed here is in litigation we should use
3 established models. Well, if you put me to a
4 litigation desk, I can always criticize
5 MODFLOW. I can always criticize MT3D because
6 they are not sophisticated enough for certain
7 applications. And we have discussed why they
8 are not because vapor exposure. They don't
9 address that.

10 So if there's a model which does an
11 additional analysis over what other models can
12 do, if it is available, why not use it? If it
13 is available in terms of duplicating what
14 MODFLOW does, why not use it? Just because
15 MODFLOW has an earlier history doesn't make it
16 better.

17 So I just want to leave it at that. I
18 think the summary here is we have to look at
19 the data. We have to look at the output
20 required. The models are just tools. We can
21 choose A, B or C if it helps us getting from A
22 to Z, then that's okay. That's all I have to
23 say.

24 **DR. ASCHENGRAU:** Dr. Aral, have you
25 validated your methods against the other

1 methods or against data --

2 **DR. ARAL:** The new method that I have talked
3 to you today or yesterday? No, that's a
4 totally new method. The only validation that
5 you have seen is on the Tarawa Terrace
6 application. That's a totally new
7 application.

8 **DR. ASCHENGRAU:** But this third thing, the
9 matrix, it may be --

10 **DR. ARAL:** Oh, yes, this solution that we
11 have, I think it's the name was not mentioned
12 but ^[TechFlowMP -ed.] ~~FLOW-MP~~ is a new 3D
13 model -- not new, started in the '90s we are
14 working on it -- does solve these equations
15 similar to the way MODFLOW and MT3D solves.
16 On top of what they do in MT3D, it looks at
17 the unsaturated zone and the vapor transport.

18 **DR. DOUGHERTY:** I think there's some
19 confusion about which model's being discussed
20 in terms of questions and answers. So I think
21 Ann was asking about the linear control where
22 it has been validated against other methods in
23 any particular way. A majority of your
24 comments, I believe, are on the multi-phase,
25 multi-media.

1 **DR. ARAL:** My comments were referring to
2 groundwater flow, contaminant transport
3 analysis aspects. Those models can get to be
4 as complicated as we want. But in application
5 we are limited, as we are hearing all day
6 yesterday and today, we are limited by the
7 data. So the complicated nature of the model
8 doesn't make it better in terms of an outcome
9 if the data is not available to use that
10 complicated nature of the model. We have to
11 accept that.

12 **DR. ASCHENGRAU:** But it's just people who
13 have been expressing their discomfort with
14 some, with what I perceive as some new method
15 that other people haven't used yet. And so
16 I'm just trying to figure out is if we can be
17 more comfortable with it because that new
18 method has somehow been compared to the
19 existing methods. And so they shouldn't be as
20 comfortable about it. That's all I'm --

21 **DR. ARAL:** That's a very good point. We are
22 not proposing this black-box model to be used
23 which was developed three months ago. We
24 accept that. We developed this three months
25 ago. And we are not proposing to use this

1 without extensively validating it in other
2 areas, in other databases, so that it
3 establishes a footing in the field. We are
4 not proposing that. We have to test this
5 model over and over again to have confidence
6 on its outcome.

7 **DR. GRAYMAN:** Getting back to your comment
8 when you referred to when you were in court
9 testifying. I think we'd all agree as
10 scientists we want to use the best, most
11 appropriate method, and that sometimes is not
12 totally in line with what you see if you're in
13 a court case, and it just isn't. I mean,
14 court cases aren't necessarily about the best
15 science. They're about whatever they're
16 about.

17 But it would almost be like if you
18 were doing climate modeling and you'd
19 developed some new climate model that had some
20 additional processes. And you felt that this
21 was definitely much better than what the
22 established methods were that were tested by
23 the IPCC and had gotten the Nobel Prize for
24 it.

25 And you're in court and you're trying

1 to say, well, my model is better because --
2 and they ask you, well, has this been
3 validated. Has it been used other places.
4 And you say, no. You're going to be probably
5 a lot better off in convincing the court by
6 using one of the established models. And then
7 so we are in a situation of science versus a
8 legal situation, and I don't know where this
9 whole thing is going to go to.

10 **DR. ARAL:** Well, I fully appreciate that,
11 but --

12 **DR. BAIR:** There's a huge change in the law
13 for expert testimony in the mid-'90s between
14 the Frye Rule and then the Merrill-Dow
15 Pharmaceutical lawsuit where the judge now
16 sits as the gatekeeper of what is acceptable
17 science. And it is up to the scientist prior
18 to the trial and the expert witnesses or the
19 engineers to convince the judge, who's the
20 gatekeeper, that what they're doing is not
21 junk science that just appeared, but it has
22 foundations and validations in the steps that
23 people have been talking about.

24 So I just, I don't know where this is
25 headed one way or the other for lawsuits. It

1 seems like everybody's walking around the hat
2 without ever putting it on. But I think that
3 effort that you've talked about has to be way
4 up front before you put any of the effort into
5 looking at a Camp Lejeune.

6 **DR. ARAL:** Oh, I agree with that.

7 **DR. CLARK:** Morris, you wanted to make a
8 comment.

9 **MR. MASLIA:** Yeah, I wanted to make the
10 point again after we completed, essentially
11 completed the Tarawa Terrace -- and you need
12 to, I guess, put your administrative
13 organizational hat on --

14 **DR. CLARK:** Doesn't fit.

15 **MR. MASLIA:** -- I know, that's a problem for
16 us. We saw the effort that it took -- and
17 there's still a question about it, I mean,
18 looking at all sides and all questions, the
19 effort that it took to get the answers that we
20 got to give to the epidemiologists.

21 And we were looking for an approach to
22 speed us up to get some initial results. And
23 we wanted an alternative because you know the
24 amount of effort and multiply it by ten for
25 Hadnot Point. That's at least by ten if not

1 by a hundred. And if we do that, December
2 2009 is not even in the question. Probably
3 December 2012 is not in the question given the
4 discussion here.

5 So we have to, I think, look at some
6 alternative ways. One way, as they said,
7 let's cut out for the time being the
8 dispersive transport and all that and look at
9 a flow path approach to get some indication.
10 Another approach is where we have the
11 information and see if we can reconstruct the
12 concentrations from that. It does not in my
13 opinion invalidate the use of either one. It
14 actually may add some additional insight for
15 us to maybe enhance the more sophisticated
16 modeling.

17 And that's what I asked Georgia Tech
18 to do because I only had one tool in my
19 toolbox, and we knew it was too heavy at this
20 point to pick up and try to fix the second
21 part of the problem. So that's really our
22 objective is to see what results, does that
23 give us some additional insight while not
24 expending as much effort and resources.

25 **DR. CLARK:** To get back to Ann's point, are

1 you thinking in terms of using Tarawa Terrace
2 as a validation tool? Because you've done
3 traditional groundwater modeling in Tarawa
4 Terrace. Could you use that example as a
5 validation tool for the linear control theory
6 model?

7 **MR. MASLIA:** Well, Dr. Aral's used that
8 already. In other words he's tested the
9 method out on Tarawa Terrace, but again, that
10 is assuming that the simulation mean values or
11 whatever are, in fact, quote, surrogates for
12 real data. Now what needs to be done, and we
13 can go to other sites, do a literature search
14 or go to other sites, let's test it out on
15 some other site data, not necessarily Camp
16 Lejeune, and see if we get similar results or
17 results that build further confidence in it.
18 The fact is that this approach does not take a
19 lot of effort to run on subsequent datasets.

20 **DR. CLARK:** Do you have some datasets that
21 you can [use to -ed.] perform those validation
22 tests?

23 **MR. MASLIA:** I can't. I don't have them in
24 hand or know of them at this point.

25 **DR. ARAL:** Just a few comments on what I

1 have heard just now. Obviously, the judge is
2 the gatekeeper and established models have to
3 be used in court cases because they are
4 established. That's the only reason. But
5 that shouldn't hinder the science.

6 In other words science has to go
7 forward in bringing new ideas, new models, new
8 concepts into the field. And in the next 50,
9 60 years maybe they will be the accepted
10 models to be used in the court cases. Can you
11 imagine a world which is stuck to MODFLOW?
12 And a hundred years from now that will be
13 extremely limited because the science is
14 advancing. We have to bring that new science
15 into MODFLOW.

16 **DR. WARTENBERG:** But it seems to me that
17 they're two different issues here. There's no
18 question that science needs to go forward, but
19 that doesn't necessarily address why we're
20 here and what we're looking at. And it seems
21 that's that's --

22 **DR. ARAL:** I know. I'm looking from a, to
23 this problem from two perspectives. I will
24 continue with this method. I will publish
25 technical papers, and then it will be applied

1 or not at Hadnot Point is a different story.

2 DR. CLARK: I'm going to suggest that we go
3 ahead with our lunch break. I do have a
4 question.

5 Scott was in the process of giving a
6 presentation, and we cut him off due to
7 ~~technological~~ [technical -ed.] error problems.
8 Do you want to try to do it during the lunch
9 period, [or -ed.] at the end of the lunch
10 period?

11 DR. BAIR: I'd rather do it later than now.
12 I just think the demeanor in the room will
13 refresh itself over lunch.

14 MR. MASLIA: Bob, if he wants to, just
15 before the end of the lunch break, because I
16 am concerned --

17 DR. CLARK: Yeah, after you have the lunch
18 break.

19 MR. MASLIA: -- because we have to meet our
20 2:30 to start summarizing because some people
21 have planes.

22 DR. CLARK: Does 12:15 work?

23 MR. MASLIA: That's fine.

24 DR. BAIR: So I can be here at 12:15? Yeah,
25 and I think what you're going to see are some

1 of the comments that Ben made about what the
2 step functions are going to look like when you
3 get to the end of this.

4 (Whereupon, a lunch break was taken between
5 11:40 a.m. and 12:30 p.m.)

6 **DATA DISCOVERY - ADDITIONAL INFORMATION AND DATA**

7 **DR. CLARK:** We're reconvening. We're going
8 to modify the agenda again just a little bit.
9 From about 12:30 to 1:30 Morris and I guess
10 Frank are going to talk about data discovery
11 issues and new [, -ed.] additional
12 informational data.

13 **MR. MASLIA:** And I'm basically just opening
14 it up and let the panel also obviously join in
15 and all that. But as you see the data that we
16 have gone through, and there's a lot of it to
17 consider. And we mentioned yesterday this
18 data that are in the notebook represents the
19 IRP Program on the base. And there is about
20 another 100-plus documents that represent the
21 above and underground storage tank data.

22 And what our proposal is or our
23 approach to do with that is to actually
24 separate this report that you have or the
25 collection of, the draft report that you have,

1 and have two sets of reports, one strictly
2 with the IRP data, and then pull out any UST
3 data from that report. And then have a
4 separate report with the UST data. That's
5 the, I think, straightforward approach to
6 dealing with that.

7 As far as from a modeling or use of
8 data in whatever form of modeling we want,
9 whether it's calibration, verification or
10 whatever, our thoughts at this time are
11 probably to try to use that second set of data
12 as almost a verification stage. In other
13 words sort of treat it as if we don't know
14 about it right now. Use what we have.

15 And then if we get to the point of
16 where we have some confidence in model
17 simulation in terms of concentrations or
18 whatever, see how it compares to this other
19 set of data. I say that because to add, put
20 this into, quote, a calibration set or
21 whatever, still does not get us over this
22 hurdle of uncertainty, variability or anything
23 else.

24 So I think it's maybe limiting the use
25 of some data that could maybe even help

1 improve our confidence in the model. That's
2 just my thoughts right now. And I think that
3 also helps us in terms of resources expended,
4 people, time, money and stuff like that.

5 And it'll help us learn with the model
6 what the models may be doing or may not be
7 doing with an existing dataset that we've gone
8 through pretty thoroughly at this point. And
9 save that other dataset in terms of modeling
10 that may, as I said, help improve our
11 confidence which may be more of an advantage
12 for us and then lumping it all together.

13 And I'll just throw it out and see
14 what the panel thinks about that approach or
15 any other approach you may have. But that's
16 our thoughts right now as to how to handle
17 that.

18 So anything else, Frank?

19 **DR. POMMERENK:** Morris, let me get started
20 on a couple comments. And I also appeal to
21 those panel members who were here in 2005.
22 You know, there were several recommendations
23 made in 2005, and if I recall it correctly,
24 and I tried to focus the discussion back on
25 this, was the whole uncertainty analysis and

1 you addressed with Tarawa Terrace some of
2 those issues where you acknowledge the model
3 results and so on.

4 We saw this was at least piece-wise
5 brought up by panel members, you know, the
6 overly optimistic narrow band in the Tarawa
7 Terrace concentrations that we need to address
8 also uncertainty in other things which will be
9 for Hadnot Point no doubt be greater. We saw
10 it with the mass computations. So I just
11 would like to recall from the 2005 panel
12 meeting that one of those key recommendations
13 was, if I recall correctly, the focus should
14 not be on so much on the little details in the
15 groundwater model and hydraulic model versus
16 trying to quantify uncertainty because in all
17 the little errors that we may make in a non-
18 representative model or whatever, may be
19 swamped out by uncertainties upstream. For
20 example, in this case the mass was disposed in
21 the first place. So I think I should throw
22 out this just to refocus the discussion. I
23 hope that the other --

24 **MR. MASLIA:** I think that your point is very
25 well taken to incorporate what the previous

1 panel said. And that was I think impacted two
2 things. One, why a lot of effort and emphasis
3 both the Marine Corps and Navy in going out
4 and hiring a company to go through their
5 records. And we spent an additional amount of
6 time going through data and information. And
7 then the second thing is, and this brings us
8 back to this morning's discussion, is why --
9 I'll say I -- I asked Georgia Tech to try to
10 come up with a simpler method because that was
11 one of the recommendations out of the panel in
12 2005 is to look maybe at the bigger picture,
13 but a simpler representation because of all
14 these factors. So your point is very well
15 taken, very well taken.

16 **DR. POMMERENK:** Yeah, just as an aside on
17 that. You know that linear control theorem,
18 we may not care about what the individual
19 coefficients of that matrix or the matrices
20 represents because we may have sources of
21 uncertainty elsewhere that would ~~swap~~ [swamp -
22 ed.] out any little issues that we may have
23 with the groundwater flow model or the
24 hydraulic model or when interconnection was
25 there or not.

1 And that's why the panel and again in
2 my recollection, recommended the increased
3 efforts in data discovery where they have
4 actually hired a company to go through all the
5 records on base. That just is a reminder.
6 And I believe that is all documented
7 recommendations of the expert panel.

8 **MR. MASLIA:** Yes, it's in the yellow-color
9 folder report there that's available both --
10 yeah, that one. It's in Section 6 of the
11 report. That summarizes it, and then if you
12 want the detailed actual final recommendations
13 you can pull out the verbatim transcript
14 that's included on the CD there. But the
15 report just summarizes that in
16 generalizations. But that is correct.

17 And I know we focused, I mean, as an
18 Agency we did. We hired more people and
19 obviously tried to go through more, and I
20 think that's how some of this discussion on
21 the interconnection came about as well.
22 Because if you recall at that meeting or the
23 generalization was made that, well, if there's
24 no very limited interconnection, well, simple
25 mixing will do the trick. And that worked

1 correctly for Tarawa Terrace.

2 That was, we looked, and we could not
3 find any instances of, I used a rule of thumb
4 of a two-week period just at Tarawa Terrace,
5 and that was correct. But in looking further
6 and actually understanding what was written in
7 the logbooks, which takes some doing, you
8 know, how they make notations and what it
9 really means. And in discussing with the
10 present and former operators, we came across
11 the short intervals but pretty much
12 consistent, but that they would turn it on in
13 dry late spring or early summer months.

14 So again, I think what we do in your
15 recommendations here are adding to the
16 recommendations of the 2005 panel. But we do
17 have a much more complex issue, and that's
18 hopefully y'all can put some recommendations
19 down that we can take to both our management
20 and the Navy and tell them what our plan is
21 for concluding the study. I think that's
22 really what Frank's looking at is an exit
23 strategy that's satisfying.

24 **DR. BOVE:** Maybe not as quickly as some.

25 **MR. MASLIA:** Well, not as quickly as some.

1 I didn't mean to imply that we're walking out
2 the door today and that's our exit strategy.
3 But, no, and that's why I think it's
4 motivating me to say with the additional data
5 that we have, let's not be quick to just use
6 it or throw it in for model calibration right
7 away. Let's see what we can understand about
8 it first, and then maybe help us improve or
9 reduce maybe some of what we perceive to be as
10 uncertainty or build confidence in whatever
11 model or modeling approach we take for Hadnot
12 Point.

13 **DR. HILL:** And just one comment on that. In
14 terms of a simpler modeling approach, it can
15 be a simpler physical-based model. That's an
16 option instead of, so there's a lot of ways to
17 ^.

18 **DR. GOVINDARAJU:** I just wanted to, you know
19 before lunch we were talking about what if it
20 were to do a court case and so on. And when
21 you're given this charge and when I started
22 looking at the document, I was not preparing
23 myself by trying to advise people by what one
24 should do in case of litigation. And maybe if
25 that is the case our objective functions

1 should be somewhat different. I thought we
2 were going to be doing this to see how we can
3 reduce uncertainty and stuff like that. So I
4 just want us to be able to explain that if we
5 should be thinking in terms of what would fly
6 in a court of law or see what we can do --

7 **MR. MASLIA:** Well, the answer is anyone can
8 sue or sue anyone at any time of the day, but
9 for anything, so no, we're not gearing our
10 study for that. What we're gearing our study
11 for is for to be able to provide the
12 epidemiologists and the epidemiologists to be
13 able to assess epi results.

14 **DR. BOVE:** Maybe I should say this. There
15 is not much in the literature about the health
16 effects of these chemicals from drinking water
17 exposures. But there's even less about birth
18 outcomes in these. So the main reason we
19 embarked on these studies was to add to the
20 scientific literature. I mean, that was the
21 primary goal here. People want to know what
22 the effects are of these chemicals. Well, we
23 have occupational data, but we have very
24 little drinking water data. We have a birth
25 defects, one study in New Jersey looked at

1 birth defects that so far has been published.
2 We have a few studies looking at cancers and
3 these chemicals. And so that's what we have
4 that are published, a few studies out there,
5 and some of them may not even agree with each
6 other or they do to some extent with very
7 little good exposure information as well. So
8 that's what the literature is out there. We
9 want to add, make a major contribution if we
10 could to that literature. That's the primary
11 goal here. It's not litigation. It has
12 nothing to do with litigation.

13 **DR. CLARK:** Dick, you have a comment.

14 **DR. CLAPP:** I was just pointing at Dr.
15 Aschengrau, who's done some of the studies.

16 **DR. DOUGHERTY:** I have two things. One is I
17 took the litigation court of law as a metaphor
18 for other courts of opinion that bear on
19 reliability and judgments of reliability.

20 Second was a question. In the data
21 that we're talking about, do we know the
22 contents of these tanks?

23 **MR. MASLIA:** You mean the contents of the
24 database?

25 **DR. DOUGHERTY:** No, what materials were in

1 these, what chemicals are we talking about?

2 **DR. CLARK:** In the new information.

3 **MR. MASLIA:** Oh, in the new information.

4 **DR. DOUGHERTY:** Yes.

5 **MR. MASLIA:** Bob, I haven't looked at it. I
6 just catalogued the information, but Bob can
7 generally describe what's there.

8 **MR. FAYE:** Some of the tanks were just pure
9 gasoline, diesel fuel, heating fuel, waste
10 oils, that's pretty much the gamut of the
11 contents.

12 **DR. BAIR:** What else could you wish for?

13 **DR. WADDILL:** Would you like me to clarify
14 that?

15 **MR. MASLIA:** Yes, please.

16 **DR. WADDILL:** In regards to the new
17 documentation, this is all leaking underground
18 storage tank program studies, records of
19 decision. Clean up information related to the
20 leaking underground storage tank program per
21 NCD nuregs*. So it's all POL contamination.
22 Any solvent contamination falls under the IR
23 Program per ~~CIRCLA~~ [CERCLA -ed.].

24 **DR. DOUGHERTY:** What about the waste oil?

25 **DR. WADDILL:** Waste oil if it's solely

1 benzene or BTEX or POL falls under the [UST
2 program -ed.]. If it has solvent co-
3 contamination it usually goes into the IR
4 Program.

5 **DR. DOUGHERTY:** Thank you.

6 **DR. ROSS:** I have a comment that that
7 information may be useful because of all of
8 the compounds, the BTEX compounds are going to
9 serve as good fruit for the bugs for one thing
10 to break down the solvents over time.

11 **DR. POMMERENK:** Okay, since nobody else is
12 saying anything, I just want to make one
13 comment so it's in the record. Because we've
14 been talking all day today and yesterday about
15 the groundwater flow model and then the water
16 distribution system model, and the one thing
17 that I would like -- that's why I want it in
18 the record -- there's a big five entity [MGD -
19 ed.] treatment plant in between, between the
20 groundwater collection system and the
21 distribution system.

22 It consists -- and correct me if I'm
23 wrong -- of a ^ [ground storage -ed.] tank. I
24 don't remember what the size is, but it's
25 probably a million gallon or larger. The

1 Hadnot Point plant has a pump station that
2 pumps water from that water collection tank
3 into what are called catalytic softening units
4 or ~~spiracteristic (ph)~~ [spiractor -ed.] cones
5 to which ^ ~~lime~~ [lime -ed.] is injected to
6 facilitate softening and it overflows into a
7 central pipe.

8 It goes from there through a ~~currently~~
9 ~~still through~~ [-ed.] a rectangular basin that
10 used to be a re-carbonation base, and I'll get
11 back to that. And from there into gravity
12 filters and you know after chlorination and
13 fluorination into a finished water clear well.

14 Obviously, in this facility there's
15 several quiescent or not so quiescent surfaces
16 from which ^ [volatile -ed.] organic compounds
17 can escape. And that kind of depends on the
18 physical properties of these compounds, PCE
19 more so than TCE and so on. We made an
20 estimate a few years ago, a rough estimate,
21 that probably PCE and TCE, we didn't look at
22 BTEX, removal would be incidental, minor,
23 probably. The tanks are covered so there's no
24 way effluents could stir up things.

25 However, what was not looked at that

1 was, because of lack of information is the re-
2 carbonation basin. The re-carbonation basin
3 serves to, it's typically a small, flow-through
4 basin to which you inject carbon dioxide that
5 is generated from a propane generator or from
6 gas bottles. And carbon dioxide is an ~~asset~~
7 [acid -ed.] in water and ~~increases~~ [decreases
8 -ed.] the pH which has been pretty high prior
9 to, because of lime addition.

10 So that's how this whole softening
11 process works. You bring the pH up you're
12 still going to have calcium carbonate. Bring
13 the pH back down within the allowable limits.
14 So as far as I know, and as far as I can
15 recall, I've never seen this basin in
16 operation. It was just water flowing through.

17 However, it was put in for a purpose
18 originally some time in the '40s, and nobody
19 can tell me exactly if it ever has been
20 operated and how long it has been operated.
21 Because if it has been operated, it could have
22 ~~been~~ [caused -ed.] substantial removal of PCE
23 and TCE. It would have been in the 90 percent
24 removal.

25 And it kind of depends on the gas flow

1 rates. It kind of depends on the turbulence
2 that got generated. So there's a variety of
3 factors that would have presented. But it
4 could have affected removal of these compounds
5 in the plant. And again, we just looked at
6 PCE and TCE as from volatilization from the
7 basins that are there, not ~~re-carbonization~~
8 [re-carbonation -ed.] because we didn't have
9 any additional information.

10 But it might be worth looking into
11 BTEX volatilization from the basins, you know,
12 whether that as a source is uncertainty again.
13 And I'm not trying to get exact numbers or
14 anything, but it's another source of
15 uncertainty for the exposure calculations for
16 what could potentially be the removal of these
17 compounds from the plant, A. And B, finding
18 out whether this has ever been online, this
19 re-carbonization basin.

20 **MR. MASLIA:** Hopefully, we're sending five,
21 six people up to Lejeune this month, sometime
22 this month, because in the BAH when they
23 indexed the records that were there, we looked
24 at the Tarawa Terrace stuff knowing that we
25 would be back to look at Hadnot Point. And so

1 there may be some information on that in those
2 records. I don't know in other words. So we
3 have not gone through the ~~BAY~~ [BAH -ed.]
4 information index and then told, you know,
5 requested that those documents be pulled, if
6 in fact, there are documents in that index
7 that would be useful.

8 **DR. POMMERENK:** You may want to look first
9 in any purchasing records of propane or
10 whatever they used. You may want to start
11 talking to Bernash* [sic -ed.] when you get
12 down next time with him. I can't imagine it
13 has never been used because it's still
14 comparable, softening plants operated by the
15 Navy or Marine Corps. Kings Bay, Georgia,
16 they still use re-carbonation basin.
17 Guantanamo Bay has recarb basins, you know,
18 it's not uncommon. So if you look for these
19 kind of records. I always find these kind of
20 things.

21 **DR. DOUGHERTY:** So, Peter, when you were
22 there and there was not ^, were they not
23 dropping the ~~TH~~ [pH -ed.] or was there some
24 other procedure that they were doing?

25 **DR. POMMERENK:** As far as in dealing with

1 that plant, they've always softened just below
2 -- well, this is the secondary MCL anyway.
3 The ~~TH~~ [pH -ed.] leaving the plant should be
4 below nine, and they're always, eight-eight,
5 eight-nine, fluctuating. Of course, you know,
6 you have a certain ~~goal-treatment~~ [treatment
7 goal -ed.], the soft pH, its hardness, and if
8 they get within their 60-to-80 milligrams per
9 liter ^ carbonated range with that pH, that's
10 -- in fact, Holcomb Boulevard is operating in
11 the exact same manner and so is New River
12 across the river when it was still operational
13 as a lime softening plant. So it's not
14 uncommon with that type of water that you
15 would soften at a somewhat lower pH and not
16 adjust it finally. So that's not uncommon to
17 do that.

18 **DR. DOUGHERTY:** I just wanted to know if
19 there was a different process that they had
20 temporarily used or if it was just as he's
21 described, and they just bumped it up just
22 enough and left it there.

23 **MR. MASLIA:** The pH throughout the system
24 was fairly high. It was higher than I've seen
25 in other distribution systems. Because when

1 Jason and I were there, we were doing the
2 field test, we first thought the instruments
3 were out of calibration because it was always
4 well over eight, 8.5, 8.8, I mean.

5 And that's why we thought there was
6 something, you know, we had to go back and
7 recalibrate the instruments or whatever to
8 make sure. But then we checked with them
9 inside, so it's a pretty high pH.

10 DR. POMMERENK: With a gain in
11 precipitation.

12 DR. ROSS: Downstream?

13 DR. POMMERENK: I can't say. I mean, you
14 know they have had problems. I have pictures,
15 in fact, one of my memos that I sent to you a
16 while ago ~~it picks up~~ [depicts -ed.] the
17 ~~spiroactors*~~ [spiractors -ed.], so they get
18 pretty badly encrusted downstream. So all the
19 softening is not done in the ~~spiroactor~~
20 [spiractor -ed.]. Softening's going to go on
21 throughout. That's been one of the hassles
22 that they've always, ^ has been complaining
23 about. Now, I cannot say for sure what, how
24 much precipitation's going on in the
25 distribution system, but, yeah, it will

1 happen. And now to bring up a point here.
2 How does that affect POCs[VOCs -ed.]

3 **DR. CLARK:** Is it possible that they had
4 cast iron pipe in the system at one time?

5 **DR. POMMERENK:** Yeah, you should be able to
6 see. We inventoried that system.

7 **MR. MASLIA:** No, the system is cast iron,
8 and then when they would replace them, now
9 presently when they replace them, they
10 presently replace them with PVC. They've got
11 a few lines of ductile iron and very little AC
12 pipe at all. So it's mostly cast iron and PVC
13 now. And one would think it was historically
14 then cast iron.

15 **DR. POMMERENK:** Two years ago we had
16 excavated some pipe, four-inch pipe, in New
17 River which is across the river on the other
18 side where they also until 2007 operated a
19 lime softening plant in a similar manner. And
20 they got water from wells in what is called
21 the ^ [Verona Loop -ed.] area which is, you
22 know, you can see it west of New River, you
23 know the left, top corner. Left top, left,
24 left, left, left, left. All the way on the
25 left is --

1 DR. DOUGHERTY: The N[M -ed.]-C-A-S, Morris.

2 MR. MASLIA: Oh, here, okay.

3 DR. POMMERENK: Right down there, ^ wells
4 from a hardness standpoint a similar
5 composition as the wells at Hadnot Point. And
6 again coming back to those pipes that we
7 excavated, I don't know exactly where they
8 came from in the system, but they didn't show
9 any large amount of scale. There was
10 ~~tuberculation~~ [precipitation -ed.] and you
11 could clearly see on there ~~tuberculation~~
12 [precipitation -ed.], various layers of all
13 the different iron oxides and ^ mixtures of
14 that. But there was not a distinct calcium
15 carbonate layer.

16 DR. DOUGHERTY: Do we know the frequency of
17 well rehabilitation just as another indicator
18 of this?

19 MR. FAYE: We have some records of actually
20 a lot of records in the early '50s and perhaps
21 up to '65, '66, '67. Then there's a gap, and
22 then beginning in '78 up through '85, '86, '87
23 we have records of gross rehabilitation. On
24 the one hand the records may indicate things
25 like notes in the margins, well down May,

1 bearings replaced in pump. Or well down in
2 October, air line replaced. Things like that.
3 So you have to make a judgment. Was it down
4 for three days or three weeks? So that's kind
5 of the extent of that kind of information.

6 **DR. DOUGHERTY:** So there's no direct
7 information that the well was acidized or ^
8 [cleaned -ed.] up or something?

9 **MR. FAYE:** In some of the records that are
10 quite detailed, I've never seen those kinds of
11 activities take place or have no indication
12 that those activities took place.

13 **DR. KONIKOW:** I wonder if some of the local
14 well drillers would have that information more
15 readily available than the Marine Corps base,
16 maybe foot work there might.

17 **MR. FAYE:** Well, that's a good question,
18 Lenny, and it's a possibility based on my
19 experiences with drillers, some of them do
20 keep really good records. On the other hand a
21 lot of folks that work for government, and
22 particularly the military, I think they took
23 their training from squirrels. They take care
24 of everything. They hide everything, and so I
25 got a strong hunch if those records were

1 available, we'd know it.

2 **DR. CLARK:** Anybody else have any more
3 comments at this point?

4 (no response)

5 **DR. CLARK:** Well, one thing that occurred to
6 me, [and -ed.] I think Frank maybe alluded to
7 it at one point, is the possible extension of
8 the study to include something other than
9 birth issues. Some of the levels that were
10 being distributed in the finished water almost
11 ~~looks~~ [look -ed.] like occupational exposure
12 levels and could [have -ed.] inhalation and
13 dermal effects.

14 And I think you've mentioned that
15 you're giving some consideration to extending
16 the study to include that, but I didn't know
17 whether you wanted to talk about it now or
18 not.

19 **DR. BOVE:** Just briefly, we have two studies
20 that we're going to embark on this summer.
21 One is a mortality study of adults obviously
22 which will take into account hundreds of
23 thousands of Marines at the base plus a
24 comparison group at Camp Pendleton population.
25 And with that, monthly data, of course, isn't

1 as relevant in that kind of a study as it is
2 with a birth outcome study, the small for
3 gestational age study or the case-control
4 study we were talking about all day.

5 The other study is a health survey
6 which is going to ask people about their, any
7 cancers they may have had and other diseases
8 that we think are related to solvent exposure
9 that we see in the occupational literature as
10 well as any information from the drinking
11 water literature, which I already said was
12 very sparse. And then we'll confirm those
13 diseases as well as we'll confirm the deaths
14 and find out the cause of death.

15 So that's roughly, without going into
16 too much detail, what we plan to use this data
17 for as well as the current case-control study
18 and the re-analysis of the small for
19 gestational age study. So any questions about
20 those two studies I can answer them, but just
21 so you know that what we produce here in the
22 water modeling will be used for additional
23 studies.

24 **DR. CLAPP:** I don't think he's talking about
25 dermal or inhalation exposure as part of the

1 extension. He's talking about different study
2 types.

3 **DR. BOVE:** Right, what we assume -- well, in
4 the health survey as well as the case-control
5 study, we do ask about people's consumption
6 habits, how long they shower, for example. So
7 that we start getting at some of those routes
8 that way. But really, we assume that
9 everyone's pretty much getting the same kind
10 of exposure. They're showering roughly about
11 the same amount. They're getting the same
12 kind of dermal exposure, and they're ingesting
13 roughly about the same amount of water.

14 **MS. RUCKART:** Frank, we don't ask about that
15 on the health survey.

16 **DR. BOVE:** We don't ask about their
17 consumption at all?

18 **MS. RUCKART:** Just the case-control.

19 **DR. BOVE:** Okay, I'm getting confused
20 between studies. That's right. For the case-
21 control study we ask that question. Actually,
22 as I said yesterday, the usefulness of that
23 information is not that good.

24 There are also civilian employees who
25 were exposed and there we're going to take

1 into account their occupational exposures as
2 well as -- and also the military have
3 occupational exposures, too, and also where
4 they drank water at their occupational sites,
5 workplaces. So these are things that we're
6 going to take into account in the future
7 studies.

8 So does anyone have any questions
9 about that? I don't want to get into that
10 because we have so much to discuss about the
11 modeling and wanting to get advice. We had an
12 epi panel actually a year ago discuss these
13 two studies and the issues there.

14 **DR. CLARK:** Any reaction to ~~your~~ [the -ed.]
15 comments or thoughts on that?

16 (no response)

17 **DR. CLARK:** I know when we were ~~doing~~, [-
18 ed.] setting a radon standard ~~in~~ [for -ed.]
19 drinking water, we looked at some of those
20 kinds of issues. So there is some literature
21 in terms of --I think it's the University of
22 Pittsburgh that actually has a physical shower
23 where you can go and measure the transfer of
24 water of the radon from the water into the
25 air. And I would assume that [at -ed.] some

1 of those levels [, -ed.] that eventually the
2 household would be basically saturated with, [
3 -ed.] volatilized with solvents [BELJIN -ed.],
4 which would apply not only to the Marines, but
5 also their dependents and children.

6 DR. BOVE: Right, and then there's also some
7 concern, for example, cooks at the, in the
8 Hadnot Point area getting heavily exposed.

9 DR. CLARK: Yes.

10 DR. HILL: Laundry workers?

11 DR. BOVE: Laundry workers, yeah. So we'll
12 be looking at them in the future studies.

13 DR. CLARK: I gathered [gather -ed.] from
14 what Mr. Ensminger was saying, that he has had
15 contacts from people who'd been on the base
16 and adults who've had follow-up health issues
17 that kind of were linked to that sort of
18 exposure.

19 DR. BOVE: That's why we have to do these
20 studies.

21 DR. CLARK: This is the quietest I've ever
22 seen this particular group.

23 **PANEL DISCUSSION: INCORPORATING AND USING ADDITIONAL**
24 **INFORMATION AND DATA**

25 DR. HILL: I don't know if we want to get

1 into this now, but Lenny and I were talking at
2 lunch about looking at the model fit, and
3 methods to do that and some of the results.

4 Lenny, am I interpreting our
5 discussion correctly and did you want to start
6 with that? So it was model fit and the use of
7 the sort of preconceived criteria for
8 measuring whether or not the future model fit
9 was going to be good enough. And I'm not
10 quite sure, this is a discussion that's sort
11 of better done with a bunch of maps on a table
12 and pointing at this and this and saying why
13 is this ^.

14 So I'm not exactly sure how much of
15 this can be done in this kind of format, but a
16 couple of general things I'll start with was
17 there's -- and I'll start with the head data
18 just as a beginning -- and essentially what
19 head data gives you is sort of the pipes of
20 the groundwater system, kind of what are the
21 directions of flow. It's sort of similar to
22 topography on a land surface, but it's fully
23 3D, and you can't see it. And it's hard to
24 figure out.

25 And so the heads and the geology are

1 essentially what we have to constrain that and
2 also where concentrations go. And so in this
3 model there were two kinds of head data. The
4 data in pumping wells essentially taken with
5 air lines, which are known to be extremely
6 problematic.

7 And so one of my concerns was even
8 that they were put on the same graph with the
9 other kinds of head data. It seemed like it
10 should be analyzed separately. And one of the
11 things that allows you to do better, too, is
12 to look for patterns within the, so the
13 residuals are the observed minus simulated.
14 And ideally, they will be random spatially in
15 the system, and any distinct non-randomness
16 suggests bias in the model.

17 And when you had observations like
18 those air line observations that have so many
19 known problems, it's really unclear whether,
20 what they represent and how much you can
21 depend on them. And it could be that some of
22 them should not be considered at all and
23 others have good information.

24 But we have to look at where they are
25 in the system and what trends they might have.

1 Does it make sense? If the pumping from the
2 well is greater, do they actually -- you know,
3 do they make sense? And a thorough analysis
4 of that was perhaps outside the realm of some
5 of these reports, but really, without that
6 analysis, my feeling was there was just a lot
7 of data kind of thrown in, and it didn't fit
8 very well, and there were some patterns in
9 that set of data.

10 In particular, if I looked at the
11 graph, there's a band that goes through a
12 certain, I think it's observed versus
13 simulated, and I think the simulated range is
14 13 to 15 or something like that. So you have
15 a band that goes through. So there's issues
16 related to that. Maybe I'll stop there. You
17 were looking like you wanted to say something.

18 **MR. FAYE:** No, actually, I agreed with
19 almost everything you say. And also, I don't
20 take exception at all to your comment that we
21 threw everything in there but the kitchen
22 sink. You're exactly right. And it just came
23 down to a choice of on the one hand we felt
24 that we would be severely criticized if we
25 didn't try to deal with the data, and on the

1 other hand we felt we would be severely
2 criticized if we did deal with the data. So
3 we came down on the side of inclusiveness and
4 did our best. In fact, I appreciate your
5 comments very much about the air line
6 measurements because, frankly, there are some
7 people that just don't believe you and me that
8 those measurements are totally perfect, but be
9 that as it may.

10 **DR. BAIR:** Who are those people?

11 **MR. FAYE:** Well, I can mention a few that
12 I'd rather ~~new~~ [not -ed.] ~~of~~ [have -ed.] met,
13 but I won't. But anyway, your thoughts, I've
14 read your notes about the residuals and the
15 variability of the accuracy of the data. Very
16 well taken, and we definitely have already
17 decided to do some major analysis of the data
18 before we try to use it in this next model,
19 and so I accept that.

20 The only point I would take exception
21 to is the, I think it's your notions about the
22 graph and the boundary lines on there. I
23 thought I was doing a good thing when I copied
24 that directly out of the USGS report, but so
25 be that as it may, it is what it is and I

1 appreciate your comments very much.

2 **DR. HILL:** In other studies I've been
3 involved in if you don't have every data point
4 somewhere, someone will come and say did you
5 pay attention? Did you do this? Did you do
6 that? But my thought is that it could be,
7 that some of those points, I think this is
8 consistent with what you're saying. Some of
9 those points can appear in graphs that are
10 used to determine a trend, and then the trend
11 is used in the model calibration so it appears
12 in the report just not as a verbatim --

13 **MR. FAYE:** Yeah, in the report obviously we
14 tried to have our cake and eat it too. We did
15 not deliberately, explicitly attempt to weight
16 the data, weight the head data. The real
17 accurate data was fine, but what do you weight
18 the other data as? Is it a 1:2, 1:1, we just
19 didn't know.

20 So we didn't deliberately, explicitly
21 attempt to weight the data from a formal
22 analysis point of view. But then on the other
23 hand we did spend a lot of time explaining why
24 one set of data was better than the other. We
25 tried to have our cake and eat it too, and,

1 yeah, I'll take that. I'll take a hit for
2 that.

3 **DR. HILL:** That's all right. I don't mean
4 to hit.

5 Let's see. Another aspect of that is
6 the idea of sort of pre-processing the data,
7 thinking about it spatially and stuff and
8 getting trends. It could be that there are
9 situations where, for example, that vertical
10 thing we were talking about where there's a
11 three-foot decline at head. It might be
12 better to use that difference it had and have
13 some observations that are changes with depth,
14 changes at head with depth.

15 And specifically, and basically take
16 your data and -- on the one hand that's three
17 feet. On the other hand you are saying you
18 think your variability is plus or minus three
19 feet. Okay, so then that begs the question do
20 you have faith in that three-foot change.

21 Is the situation such that because of
22 where the well is or blah-blah-blah-blah-blah,
23 that you really think it is pretty close to a
24 three-foot decline which means when you take
25 that difference, you're getting a small,

1 you're getting rid of errors that might be
2 constant in some manner and actually the
3 difference, you have more faith in the
4 difference than the actual values.

5 **MR. FAYE:** No, actually, those are very
6 accurate measurements. So, yeah, I can answer
7 both because that's a bona fide well cluster
8 for the State of California. So it's good
9 data. I mean State of North Carolina. My
10 dreams have overtaken reality there for a
11 second. But we really didn't have data like
12 that to that detail, Mary, at Tarawa Terrace.

13 But we've got gobs of data in the
14 Hadnot Point-Holcomb Boulevard area where we
15 have well clusters, vertical gradients and
16 both at substantial depths even. So we can
17 really identify those issues in some pretty
18 good detail using actual field data. And it
19 would be typically like you would suspect.

20 In the Berkeley Manor area they're
21 sort of in the center of Holcomb Boulevard,
22 which is a highland area, your vertical
23 gradients are downward. You're close to the
24 Wallace Creek and other major drainages.
25 You've got your heads coming up. HPIA is a

1 similar area. It's in a highland area. You
2 know, your vertical gradients are downward, et
3 cetera, et cetera. So it all fits a pretty
4 good conceptual ~~Hubbard~~ [Hubbert- -ed.] type
5 model of the flow system, so it works pretty
6 well.

7 **DR. HILL:** Yeah, it's the graphs ^.

8 **DR. BAIR:** I was just going to say I think
9 that that's a really worthwhile calibration
10 target under a transient flow because you're
11 going to have certain pumping conditions that
12 either exacerbate or mitigate that vertical
13 gradient. And if you incorporate that as a
14 calibration target, that in turn, helps you
15 pin down the hydraulic conductivity to the
16 confining layers which so far one foot per day
17 because it's the confining nature that's going
18 to give you that large gradient, only a small
19 grade.

20 **MR. FAYE:** Absolutely, and also from a
21 limited number of aquifer tests, and again you
22 have the scale issues that you have to deal
23 with in terms of point data versus
24 extrapolating it out to a large model cell and
25 all that. But we do have some fairly decent

1 data, ~~Noyman~~[Neumann- -ed.] Witherspoon* and
2 where we've been able to apply some nice
3 aquifer test analyses and determine ~~leak-ins~~
4 [leakance -ed.] of confining unit. So for
5 whatever it's worth on a scale issue or a
6 scale-dependent value, we do have some of
7 those data.

8 **DR. KONIKOW:** Well, this also gets to, I
9 mean this first modeling phase, which
10 developed a steady state, full model
11 representative of pre-development conditions.
12 And that's part of our concern, I think, on
13 the data that you use in the calibrations is
14 that much of the data is so influenced by
15 transient conditions that it just probably
16 shouldn't have been in there.

17 **MR. FAYE:** That's really not true. And that
18 wasn't true at Tarawa Terrace either although
19 I think one of you gentlemen might have,
20 someone might --

21 **DR. KONIKOW:** I thought you were saying that
22 some of these, some of the data used from all
23 those measurements were influenced by --

24 **MR. FAYE:** They are. They are. But those
25 data were not used, to the best of my

1 knowledge, in determining the pre-development
2 surface. And also at Tarawa Terrace I think
3 there were like 50 or 60 measurements that I
4 listed in the report that I said, okay, these
5 were estimates of pre-development heads. And
6 someone did mention that they were possibly
7 influenced by pumping, and that is correct.
8 Six of those 60 were perhaps influenced by
9 pumping, but I --

10 **DR. KONIKOW:** I'm talking about the 5,000 or
11 so observations that were --

12 **MR. FAYE:** A number of those, Lenny, if
13 you've got ten years of data, and you can see
14 how it varies over time and the data are near
15 a pumping well, and you can see -- or a supply
16 well, and you can see some or infer that they
17 are being, that the heads are being influenced
18 even though the screens in the supply well are
19 rather deep, and you're looking at shallow, et
20 cetera, et cetera.

21 But you have ten years of data to look
22 at. So you can either select a data point
23 that seems to be the highest point or the one
24 that isn't influenced if you really, really,
25 really want to use that point as a control

1 point or you can disregard it.

2 But obviously 5,000 measurements,
3 hundreds of sites distributed throughout the
4 study area, you have an opportunity to filter
5 your data pretty readily. And at most of the
6 sites there was no, virtually no influence
7 except seasonal influences. And if you got
8 20, 30, 40 measurements over ten years, you
9 take an average, et cetera.

10 So that's pretty much the way those
11 control points were developed. There was a
12 pretty serious effort to filter out influences
13 from anything other than seasonal variations.

14 **DR. KONIKOW:** Okay, I didn't gather that
15 there was, but okay.

16 **DR. DOUGHERTY:** In the ~~permutation~~
17 [presentation -ed.] it said that there were
18 some obvious ones to pull.

19 **MR. FAYE:** Pardon me? Oh, Rene said
20 yesterday that he needed to look at some of
21 the data in addition. If he said it, I
22 believe it, but it wasn't a pervasive issue
23 with respect to the representation of the
24 potentiometric surface that he's showing. I'm
25 pretty sure of that, that he showed.

1 **DR. KONIKOW:** Now, when you go from the
2 steady state model ultimately you'll be going
3 to a transient model. I think you have to be
4 open to the idea that your boundaries and
5 boundary conditions and discretization,
6 particularly the vertical discretization, that
7 may be adequate for a steady state model,
8 might prove inadequate for a transient model.
9 And you may have to go back and revisit.

10 **MR. FAYE:** Absolutely. Those are, that's
11 good advice, and I believe that we've got our
12 arms around that issue pretty well.

13 **DR. KONIKOW:** On a more philosophical level
14 perhaps, I'm not sure I saw the value of
15 setting, you know, pre-determining calibration
16 targets in terms of accuracy and fitting. I'm
17 not sure I saw any outcome.

18 In other words it's just something to
19 measure against and one of the values of doing
20 that is you're assessing the accuracy of the
21 observations. But beyond that saying that
22 your goal is to come within plus or minus
23 three feet or 12 feet, I don't see the value
24 of that if you don't meet the target and then
25 don't do anything about it.

1 **MR. FAYE:** Well, that's not true because
2 it's a target that you meet as well as you
3 can. So what you see as far as Tarawa Terrace
4 is concerned is our best effort to meet the
5 target. So you don't know what the worst --

6 **DR. KONIKOW:** You're always making your best
7 effort to do the best that you could.

8 **MR. FAYE:** That's right. But before I get
9 to the issue though of calibration standards,
10 good or bad, though, you didn't see what our
11 worst effort was. So we progressively got
12 better and better and better. So you saw our
13 best effort in terms of the calibration
14 standard.

15 And, frankly, I agree with you a lot,
16 and I agree with what Mary's comments were and
17 her notes as well. From a practical point of
18 view I think having some explicit standards up
19 front at the initiation of calibration are
20 kind of a good idea. It gives you sort of a
21 target to shoot for based on your best
22 judgment about the quality of data, et cetera,
23 et cetera, et cetera, but at the end if you,
24 whether you really represent it as such or
25 don't, I don't really see it as a major issue.

1 **DR. KONIKOW:** Well, I mean, I'm just getting
2 at what does it mean.

3 **MR. FAYE:** It was more of a tactical tool to
4 provide some guidance perhaps I could say
5 during the calibration process rather than
6 something that we, and I think Mary made the
7 point that you might focus too much on
8 appeasing the standard rather than on the
9 conceptualizations and all the other things
10 that relate to a good calibration process.
11 But I don't think --

12 **DR. KONIKOW:** I mean, my concern is it's not
13 a standard. There's no standard approach for
14 doing that and picking a number ahead of time
15 really is rather on the arbitrary and
16 subjective side and doesn't lead to any action
17 afterwards when, I think, in the steady state
18 there were, if I recall, 55 percent of the
19 wells or the observations fell outside the
20 pre-determined calibration limits. And so
21 that's not a very good, you didn't meet the
22 target.

23 **MR. FAYE:** Well, I would also say that that
24 effort is, as Morris said this morning, that
25 that effort is somewhat to substantially

1 incomplete right now. I mean, it was just a
2 point in time that the staff said, okay, this
3 is as best as we're going to do up to this
4 time to get a notebook ready to send out to
5 the peer review panel.

6 Your point's well taken. I'm not
7 really arguing with you at all. I'm just
8 saying that in terms of what I did, what I
9 personally did and what I personally used it
10 for was, like I said, sort of a tactical tool
11 to make me feel warm and fuzzy if I got close
12 to it during calibration.

13 **DR. BAIR:** I guess what I'm hearing is the
14 panel people saying that philosophically that
15 they don't really care for that type of
16 criterion. And we would recommend that you
17 kind of drop it. I'd much rather not meet a
18 really stringent requirement than barely meet
19 a very loose one myself. And I think a more
20 accepted calibration target might be the mean
21 absolute error over the total relief in the
22 water table surface. So if you're at 100 feet
23 of relief and your mean absolute error is ten,
24 you've got about a ten foot error over that
25 distance. If you're in a mountainous terrain,

1 you have 1,000 feet of relief, a 100 foot
2 error is ten percent. You're in a very flat
3 terrain --

4 **MR. FAYE:** Well, we have -- if you look at
5 our good data, you know, the what we call the
6 monitor well data, I think our mean absolute
7 error for almost 300 of those data points was
8 less than two feet. And we have a total
9 topographic, i.e., water table drop of about
10 30 feet. On the other hand if you look at the
11 air line data --

12 **DR. BAIR:** Yeah, dump the air line data.
13 They're ruining you.

14 **MR. FAYE:** Your notion of being ruined might
15 be my notion of saving my ass, so that's kind
16 of a relative thing. But it is what it is,
17 and I accept the philosophical, it's really
18 not a philosophical difference of opinion. As
19 I said, I agree. And how we apply that, and
20 how we use it will hopefully be more pleasing
21 to y'all the next time around.

22 **DR. HILL:** I think, just one thing I want to
23 say is when you publish a standard, when you,
24 I don't mind you having that in the back of
25 your head and feeling warm and fuzzy when you

1 make it, but when you put it out front in the
2 beginning, you set an expectation up. And I
3 think it's that disappointment of expectation
4 that you're having trouble with.

5 **MR. FAYE:** I agree, no problem.

6 **DR. CLARK:** We have a comment. Randall has
7 a comment.

8 **DR. ROSS:** Just a question. Out of the
9 5,000 or so historical measurements you had,
10 it seems like you said a minute ago you took
11 the average, but I seem to recall you tried to
12 take the highest elevation. And in a
13 situation where you have precipitation ranging
14 from less than 40 inches to 80 inches between
15 years, would the high measurements kind of
16 bias?

17 **MR. FAYE:** Yeah, there's no question about
18 that. And if you're referring to the Tarawa
19 Terrace, we only had less than a hundred
20 compared to the 5,000 or so there. So we
21 really didn't have an opportunity to select
22 through a lot of data for Tarawa Terrace. I
23 can't even recall now. I think there was
24 something like 60 measurements that we
25 actually ended up using to estimate a pre-

1 development surface. Some of those were
2 earliest in time, and some of those where we
3 might have had two or three multiple
4 measurements at the most other than the air
5 line data. Again, let's not deal with that.

6 **DR. ROSS:** I'm with Scott. Bag the air line
7 data.

8 **MR. FAYE:** Yeah, bag the air line data. But
9 the good data, and those were all what I would
10 call high quality data that we used there for
11 that potentiometric surface. Where there were
12 two or three measurements that we actually did
13 have at the same point, I might have used
14 again the highest there, not necessarily the
15 earliest in time but the highest. It was a --

16 **DR. ROSS:** And something that we see at
17 sites all over the place is the lack of good
18 survey data for the wells. It's, for god's
19 sake given the cost of surveying the
20 monitoring points is nothing compared to the
21 other efforts that are going on at the site.

22 **MR. FAYE:** Again, most of those data that
23 are in that table for that use, those points
24 were surveyed in. And I don't know whether
25 it's actually explicitly noted in the report

1 or not, but it's true with all the tables in
2 Chapter C, if you happen to see head data
3 reported to the tenth of a foot, those were
4 all surveyed-in points. If you happen to see
5 data published to the nearest foot, those were
6 estimated from topographic maps or something
7 like that. I don't know that it's explicitly
8 said in that report, but that was the protocol
9 that was used.

10 **MR. HARDING:** Dr. Faye, let me ask a
11 question on that because I thought I saw in
12 there -- I'm poaching on the groundwater folks
13 -- a plus or minus two and a half foot
14 standard for those ground surfaces that were
15 taken from the topographic maps. Why can't
16 that be refined at low cost nowadays? I'm
17 just curious. Is that worth the effort to go
18 refine that since you've got this N-square
19 error of two feet? It seems like it's a
20 pretty big chunk of it.

21 **MR. FAYE:** I think it might be mixing some
22 apples and oranges there.

23 **MR. HARDING:** It could easily be.

24 **MR. FAYE:** To answer your first question,
25 no, I don't think it would be worth the cost

1 of refining those data at all. Second of all,
2 most of those 5,000 measurements that we
3 talked about for Holcomb Boulevard/Hadnot
4 Point, 5,000 plus measurements, I would say,
5 well, certainly the vast majority of those
6 relate to wells that are surveyed in.

7 And your two and a half foot issue
8 there is kind of a, I don't know whether it's
9 ever been formally recognized, but in 30 years
10 of work sort of a standard rule of thumb that
11 I've always used to estimate that altitude
12 using topo maps was plus or minus one-half the
13 contour interval. And the standard contour on
14 these maps that we were using was five feet,
15 i.e., the two and a half plus or minus rounded
16 off to make it simple to three feet. And
17 that's where the three-foot standard came
18 from.

19 **DR. DOUGHERTY:** Just to follow on, first,
20 I'm working on a project with some reasonable
21 data of questionable quality for reference
22 elevations, and we used a similar topographic
23 approach. So I'll just give you some
24 validation on that. But, and you can do it,
25 because it's not that expensive, but sometimes

1 it is. The thing I was going to talk about
2 was where these calibration curves, and again
3 this single plot that we're looking at, the Q-
4 Q plot or the one-on-one plot. If I didn't
5 have the units' ~~little blanks~~ [unit slope -
6 ed.] to guide my eye, I would not get a one-
7 on-one slope for this. I would say this is on
8 an inclined line that has a break point and
9 the slope of each leg, neither one has a slope
10 of one. So this is a fine type of plot, but
11 if you did the residuals versus the head, I
12 think you'd find that the errors are not
13 homoscedastic, and it would lead you to, the
14 residuals are not constant with the observed
15 heads.

16 **MR. FAYE:** I'm not sure there's a sexual
17 preference to the points but --

18 **DR. DOUGHERTY:** It's more political because
19 you've got red points and blue points. I did
20 notice that. Where are the purple points? If
21 you looked at these residuals as a function of
22 observed head, I think you'd find that there
23 is a structural issue that might inform you
24 how to go forward from here.

25 **MR. FAYE:** No argument. I think Mary

1 articulated those issues I think really,
2 really well in her notes and we acquiesced on
3 behalf of the project. I'll just say that we
4 acquiesced to those sentiments and heartily
5 agree, and we'll follow through on that. No
6 problem.

7 **DR. HILL:** So we have yet the concentration
8 data to discuss? And are we ready to go on?

9 **DR. CLARK:** I'm going to suggest we take a
10 break. A couple of housekeeping things. Who
11 has flights that are going to be tight?

12 (multiple responses)

13 **DR. CLARK:** Anybody else?

14 (no response)

15 **DR. CLARK:** Liz, can we make sure that they
16 get some better transportation?

17 (Whereupon, a break was taken between 1:40
18 p.m. and 1:55 p.m.)

19 **DR. CLARK:** First, Mary would like to start
20 a discussion on the concentration
21 calibrations. And then after that, we'll do
22 that for about ten minutes, and then we're
23 going to go around the panel, and I'm going to
24 ask for every panelist to give his opinion and
25 summarize for the record. And I think Walter

1 and Ben are tight on time. Who else, somebody
2 else was going to go with you in your cab.
3 Dan, okay, so three, so when we start out I'm
4 going to go with Walter, Dan and Ben.

5 **MR. HARDING:** I don't think we're that
6 tight.

7 **MR. FAYE:** That's really famous last words.

8 **DR. CLARK:** Well, let's start the discussion
9 that Mary wanted to have.

10 **MR. HARDING:** Then we have a three o'clock
11 cab.

12 **DR. HILL:** This will be real quick because
13 Lenny's laid all the foundation or the
14 foundation I was interested in. And that is
15 to take the concentration data and first
16 calibrate, use it to derive effective
17 transport paths and use those to calibrate
18 first to get yourself in the right direction
19 and then obviously, and then really manage
20 your water table non-linearity to your
21 advantage.

22 Don't let it, because that can add 50
23 percent to a project. It's amazing. And then
24 when you do bring the concentrations in you
25 can weight them so that you can consider your

1 heads at the same time and your stream flow,
2 we talked about the stream flow gains. I'll
3 open it up if anybody has questions or
4 comments about that.

5 **DR. KONIKOW:** You kind of mentioned earlier
6 that you have quite a lot of variability over
7 short periods of time in the observed
8 concentration. And that's really going to be
9 a big obstacle to calibrating the model.

10 **MR. FAYE:** It was and it is.

11 **DR. KONIKOW:** Look at Figure F-16 in your
12 Tarawa Terrace report. You have this
13 simulated curve that's coming up, a nice
14 smooth curve, and then there's one point in, I
15 guess, 1985, where you have five frequently,
16 samples collected over a short period of time
17 --

18 **MR. FAYE:** I know.

19 **DR. KONIKOW:** -- and they have a range much
20 greater than the long period of the --

21 **MR. FAYE:** I know. I know, Lenny. Let me
22 make a comment on that, and in part of my
23 comment I'll reference, for example, the Table
24 C-7, if you want to check that out.

25 **DR. KONIKOW:** Yeah, I've got it right here.

1 **MR. FAYE:** There's a lot of reasons for
2 variability of the concentration data. I'm
3 not going to go over all that again. We know
4 sampling, et cetera, et cetera. And the point
5 that I'm about to make I also make in Chapter
6 F, perhaps not well, but I attempt to make it
7 anyway.

8 My belief is that the major
9 variability that you're looking at in terms of
10 TT-26, I think in about a 28-day period,
11 there's a two and a half order of magnitude
12 difference in the water quality that was as a
13 result of sampling at this well. The highest
14 measurement and the earliest measurement, I
15 think which was about 1,580 micrograms per
16 liter, that's the greatest measurement, and
17 that's the earliest measurement.

18 That was sampled actually when that
19 well was probably still operating routinely
20 before they formally shut it down or was very,
21 very, very close to the time that they
22 actually shut it down. And the subsequent
23 samples there that were compressed within
24 about a three- or four-week period of time
25 were, my guess is -- this is my supposition --

1 were probably sampled with perhaps the well
2 turned on to evacuate maybe two or three
3 casing volumes or something like that.

4 And as a consequence, the result was
5 the fact that there was not a lot of
6 contaminants solute in the well at that time
7 at a concentration that would have been there
8 if the well had been operating for 12, 13, 16
9 hours, whatever, and more that mass of, from
10 the center of mass of a plume had been
11 attracted toward the well at the time.

12 And we see that. I give an example
13 with respect to TT-23 in Chapter E, I believe,
14 and Chapter F where indeed TT-23 was operated
15 for two hours and sampled and then operation
16 continued for another 22 hours so it was
17 operated for a total of 24, and the
18 contaminant concentrations doubled in that
19 period of time.

20 So my point is, after this long and
21 drawn out craziness, is that there's an issue
22 of how these supply wells were sampled in
23 terms of the length of time that they were run
24 prior to sampling. And I think that accounts
25 for a large amount of the variability that

1 we're seeing.

2 And you can look at 602 is another
3 example on page C-7 that the analysis there on
4 November 30th, 1984, that well was still
5 operating routinely at that time. And it was
6 very shortly after that shut down, and then
7 subsequently sampled quite frequently at week
8 intervals or several day intervals after that.
9 But it was not operating routinely at that
10 time.

11 Well, the latest data, water quality
12 data, that we have for the supply wells, I
13 think as far as data that I have, is for the
14 year 2000, and there was a massive undertaking
15 on the base as well as over at the air station
16 to sample supply wells at that time. And the
17 protocol observed for sampling at that time
18 was to let all of the supply wells run for 24
19 hours and then sample them. So I think
20 finally the issue, the sampling protocols,
21 were catching up to the real world finally by
22 the year 2000.

23 **DR. KONIKOW:** So this gets at really a basic
24 issue of when you get to the calibrating the
25 ~~solu~~ [solute -ed.] transport model, what are

1 you calibrating it against?

2 **MR. FAYE:** We made a point in Chapter F, I
3 believe, that we, again, perhaps we tried to
4 have our cake and eat it too, and maybe got a
5 ~~stomach-ache~~ [stomachache -ed.] over it, but
6 we made a point that we say that we believe
7 these data are more realistic in so many words
8 than other data. And again, it was this
9 earliest in time data.

10 **DR. KONIKOW:** Shouldn't you say that before
11 you calibrate the model though?

12 **MR. FAYE:** Pardon me?

13 **DR. KONIKOW:** Shouldn't that, I mean, in
14 keeping with your setting of pre-calibration
15 targets, shouldn't your decision about which
16 data are more reliable for a calibration
17 bracelet[bracket -ed.], that assessment should
18 be made before you decide to see which fit
19 match better.

20 **MR. FAYE:** We did. Those statements are
21 made in Chapter E which is a summary of all
22 the water quality data, and that was clearly
23 before we attempted to do any model
24 calibration or anything like that.

25 **DR. HILL:** But yes but, you didn't then use

1 that information and perspective to inform how
2 you actually conducted your calibration. And
3 let me just provide an example of that -- and
4 there's a bunch of things that come in here.

5 One is that you have this very long in
6 time kind of base model. And that's your goal
7 is to get this as accurate as possible. But
8 you end up having detailed concentration
9 information at different times along that
10 path. Now, you're using a methodology because
11 you have to sort of degrade your model and
12 because it's a long time period, you're using
13 a solution method for your transport that has
14 a lot of numerical dispersion, but it's fast.

15 Okay, so that's fine for your sort of
16 long-frame model, and when you get to that
17 point in time where you're trying to match
18 information at that well, it's probably a
19 higher concentration I would say that's going
20 to be consistent with that methodology. But
21 you could also take your model as calibrated
22 and for a fairly short simulation use a
23 methodology, a method that has very low
24 numerical dispersion.

25 You're going to have to figure out

1 your initial condition, your initial
2 concentration conditions. And then compare
3 that simulation, basically, what your short-
4 term, temporal data is telling you is that
5 once that well stops pumping, that it's the
6 pumping of the well that's making the plume
7 come over there. That if you stop pumping the
8 plume's going to recede. And you could test
9 to see if that occurs given the flow field you
10 have.

11 **DR. BAIR:** On a short-term basis.

12 **DR. HILL:** On a short-term basis. So there
13 might be some combination of kind of this
14 long-term calibration and then some short-term
15 simulations that test certain hypotheses.

16 **MR. FAYE:** Yeah, we did that at Lenny's
17 suggestion for another reason, basically, to
18 look, not to test the retreat of the mass,
19 contaminant mass in the plume, but we did that
20 to test the possibility of numerical
21 dispersion. We came right down to one-day
22 stress periods, so that's easy to do. And
23 that's a good idea. We can give that a try.

24 **DR. HILL:** And you can use one of the
25 solution methods then that's --

1 **MR. FAYE:** Oh, not only that. We can
2 actually use some of the field data that we
3 have to test that out.

4 **DR. CLARK:** As worthwhile as this discussion
5 is, I'm afraid we're going to have to cut it
6 here, but first off let me thank, in case I
7 don't get a chance to do this and they have to
8 leave in the middle of this discussion, I'd
9 certainly like to thank everybody for their
10 input, attention, perseverance and patience
11 for putting up with us. It's been very
12 interesting, and I hope it's been very useful
13 for ATSDR. I think it has.

CHAIR SOLICITS RESPONSE TO CHARGE FROM EACH

14 **PANEL MEMBER**

15 Why don't we just start with Walter.
16 We'll go around the table with Walter. I
17 guess Walter, Dan and Ben might have to leave
18 before we're finished. So, Walt, we'll start
19 with you.

20 **MR. MASLIA:** If you would, obviously all
21 comments are welcomed and desired, but if you
22 could try also to specifically address the
23 questions --

24 **DR. CLARK:** That were in the charge?

25 **MR. MASLIA:** -- that would help us out. And

1 anything else above that, that's also fine.
2 It would help us out if you focus.

3 **DR. GRAYMAN:** I'll start by seconding Bob
4 and just say it's been quite a privilege in
5 working with this distinguished group. And I
6 think this has been an excellent and hopefully
7 very useful to ATSDR. Thank you, Morris;
8 thank you, Liz, for organization, and the rest
9 of the group.

10 I'm going to concentrate on the area
11 of water distribution system analysis in my
12 comments. First of all, the previous work
13 that ATSDR has done in developing a detailed
14 water distribution system model has put them
15 in a good position to move forward in
16 analyzing the Hadnot Point and Holcomb
17 Boulevard during the interconnection periods.

18 Second, the water distribution system
19 analysis is going to be needed for analyzing
20 the impacts on Holcomb Boulevard, primarily
21 the Berkeley Manor area during the
22 interconnection periods with Hadnot Point.
23 For other times in the areas the mixing model
24 approach used in Tarawa Terrace should
25 suffice.

1 I think that the analysis of the
2 Holcomb Boulevard system during
3 interconnection can be separated into two
4 types of analysis, first of all the
5 groundwater wellhead, water treatment plant
6 type of analysis that was done in Tarawa
7 Terrace and second the distribution system
8 analysis, and I think it's important that they
9 can be separated. And it can take place by
10 using the distribution system model to
11 calculate the percentage of water from Hadnot
12 Point reaching points in Holcomb Boulevard.
13 In other words for each node in Holcomb
14 Boulevard you calculate the percentage of the
15 water reaching it at any time that comes from
16 Hadnot Point. Subsequently, the
17 concentrations reaching the customers can be
18 estimated by overlying that percentage of
19 water from Hadnot Point with the calculated
20 concentrations leaving the Hadnot Point water
21 treatment plant.

22 For assuming the concentrations
23 leaving the Hadnot water treatment plant can
24 be estimated probabilistically on a monthly
25 basis, then with a manageable amount of effort

1 in the distribution system area, I think that
2 a monthly probabilistic estimate of
3 concentrations reaching the Holcomb Boulevard,
4 Berkeley Manor customers can be made. And my
5 question for the epidemiologists is, is this
6 an acceptable form of results for them to
7 analyze.

8 And finally, the detailed data that
9 was available for that 1984-'85 period when
10 Holcomb Boulevard water treatment plant was
11 offline should be studied and used at least as
12 a partial validation exercise. However, it
13 really is not that useful as calibration
14 because of the operation during that period
15 was so different. That's all. Thank you.

16 **DR. CLARK:** Thank you.

17 Mary.

18 **DR. HILL:** Let's see. One thing I did want
19 to mention that I hadn't mentioned previously
20 was that, Morris, you had spoken about a
21 timeframe of 2012 for the modeling at one
22 point. And I think really that you can, I
23 actually do think the November deadline is
24 tight, but that something like next May is
25 plausible. So that's the kind of extension

1 that I might consider if recommending.

2 So that's one issue. The other issues
3 I've really, we've just been talking about
4 them, and I'm going to focus on the
5 groundwater model, but the issues of being
6 more strategic and more hypothesis testing
7 kind of focused in some of the testing that's
8 done with the model and that comes into
9 working with the observations in a more kind
10 of strategic way, having observations that
11 represent more solidly specific kinds of
12 dynamics in the system including vertical
13 flow, maybe even flows in different directions
14 you could have or have differences in
15 different parts of the model.

16 You might break it down
17 geographically. It'll depend on draw-downs
18 over time. That's another option. But having
19 graphs of residuals that make a little bit
20 more physical sense so it can be interpreted
21 better. Observations of any kind of stream
22 flow gain and loss that you can get your hands
23 on is just a really great cross-check.

24 In connection with that as well, you
25 might define, you might keep track of the

1 flows going in and out of the ~~conson~~-(ph)
2 [constant -ed.] head boundaries along the
3 rivers. Not that you have a very good handle
4 on what the values should be, but you might be
5 able to say that value's ridiculous.

6 And in terms of the concentrations, I
7 think we've spoken quite a bit about that.
8 Since we just did it I won't repeat. In terms
9 of the parameters for the model, obviously
10 we've talked a lot about over-fitting and
11 trying to avoid that because usually an over-
12 fitted model doesn't have great predictive
13 capability. And you can demonstrate that to
14 yourself with your model, using suppressed
15 validation exercises and stuff.

16 And being a geologist in my undergrad
17 and engineering in my grad, in grad work I
18 tend to really want to constrain models with
19 geology a lot, so I tend in that direction.
20 And I think this system has potential for
21 perhaps doing that more than has been done.
22 And that's all I have. Thanks.

23 **DR. CLARK:** Thank you.

24 Dave.

25 **DR. DOUGHERTY:** Here again, it's been a very

1 interesting couple of days, and I know I've
2 put a little bit of water from the fire hose
3 on the end. I suspect I'm not alone. I guess
4 my reactions are kind of mixed because in some
5 ways I feel we're coming in quite early in
6 this process, and in some ways we're coming in
7 a little bit late in the process. I'm not
8 sure exactly where the balance is.

9 But to try to answer the basic
10 questions, there seems to be a reasonable
11 possibility of delivering data useful to
12 epidemiologists with some periods of time
13 where that[data -ed.] may be less reliable
14 than others. And this interconnect time I
15 think is one that's going to be a little
16 testy.

17 We've talked about the data analysis
18 somewhat, some things to do with taking the
19 January '95 period data and doing a very
20 simple mixing model to make sure we have some
21 sense of measurement errors, either, not sure
22 of the treatment plant or to the production
23 well, but it will give us some sense of one
24 measure that we can use that constrains or
25 informs concentration measurement errors

1 because I don't feel we have a very good
2 handle on that.

3 In terms of calibration we talked
4 about looking at different ways of
5 representing the residuals so that we can
6 extract some information rather than just
7 saying we've made it, -- and I haven't seen
8 Mary's notes, so I don't know the details of
9 what she's given, but I'm sure she's given
10 them all, all the various plots.

11 On the concentration calibrations
12 looking forward, we didn't get into a
13 discussion of the treatment of non-detects in,
14 lower bounds of non-detects in the calibration
15 process. But they are, as I read it for
16 Tarawa Terrace, they're set at one microgram
17 per liter no matter what the detection and/or
18 reporting limit may be. That seems to me
19 inappropriate.

20 Think about it, another way to do it
21 if you're limited by taking logarithms, take
22 the log of one plus the concentration so that
23 your variable can be logged without blowing up
24 on you. Do something, use the data better
25 where it's limited.

1 ~~Simpler~~ by [Simplified -ed.]
2 physically-based models are the way to go. I
3 like the idea of pursuing a second path that's
4 totally data driven, but it can't be used in
5 preference to before the physically-based
6 modeling systems. I don't think it's
7 worthwhile spending a lot of time on fancy
8 transport systems. Try to keep them
9 relatively simple. The approach that Lenny
10 talked about earlier really simplifying,
11 grossly simplifying the transport processes
12 and getting some representation of early
13 arrival times makes a lot of sense to me.

14 With respect to arrival times, I would
15 note that in the documents at Tarawa Terrace
16 that both densities seemed out of line. There
17 may be a nomenclature issue. Both densities
18 were around 2.8 or 2.9 because I calculated
19 them. It seemed a little like one too high.
20 So it may be a nomenclature issue. It just
21 needs to be clarified and get it right so
22 we're not retarding excessively. Thank you.

23 **DR. CLARK:** Ann.

24 **DR. ASCHENGRAU:** Well, I just want to say
25 from an epidemiologist perspective, and it

1 might seem strange given the discussion of the
2 last two days, but that this is really state-
3 of-the-art, even beyond the state-of-the-art
4 epidemiologic study of drinking water
5 pollution. And what's been done here just
6 goes way beyond what's typically done in most
7 epidemiologic studies that have been able to
8 find effects and associations. So I have in
9 spite of all the problems we've heard about, I
10 have every confidence that the study has a
11 very good shot at finding an association if
12 it's there.

13 My problem comes more from the size of
14 the case control study, that that's a
15 limitation. But I'm heartened to hear also
16 that the great efforts that have been
17 undertaken will be used to reanalyze the prior
18 analysis of small for gestational age in the
19 two planned studies. So that's really
20 excellent.

21 That being said I also want to
22 reiterate the point that I made yesterday that
23 the Department of Navy should make every
24 effort to identify and give to ATSDR all of
25 the relevant data that they need to do the

1 best job possible and that they need to do
2 this immediately. I think it's a real shame
3 that they now have to go back and reanalyze
4 the study data from before because they didn't
5 have all of the necessary information.

6 I do think that the goal should be to
7 try to get monthly data for the current study,
8 so monthly exposure data that should be the
9 goal that people are aiming for. And that,
10 you know, if you don't reach it, that's okay.
11 Epidemiologists have never been stopped by
12 having imperfections in their data. It
13 doesn't stop us.

14 And the other impression I've had is
15 just that there are sort of lots of possible
16 sensitivity analyses that can be done with the
17 groundwater modeling, the distribution water
18 modeling. It just seems like a huge, huge
19 job, but that somehow some plan has to be made
20 for developing what needs to be done, and it
21 needs to be done strategically. And that the
22 goal should really be to keep the
23 epidemiologic study in mind and not spend a
24 lot of time on things that really won't make
25 such a difference in the exposure assessment

1 for the study.

2 In terms of just some particulars,
3 they're not so much to do with the exposure
4 modeling, but for the case control study of
5 cancer, I do think that the exposure
6 assessment should go beyond the first year of
7 life and that it should go up to the time of
8 the diagnosis of the cases and some comparable
9 date of the controls. That that may end up
10 being a large source of error if that's not
11 done. So you may have to go back and get
12 supplemental data from the study subjects or
13 somehow get that data from records.

14 And the other thing, well, is the
15 school. That really high value at the school
16 is problematic. And so I think that you
17 should monitor or assess the exposure, not
18 just at the residences but at the schools.
19 And so that would only be really relevant for
20 the cancer study I think at this point. And
21 that that source of exposure should be taken
22 into account.

23 And then my last point has to do with
24 the behavioral data so it's the water
25 consumption habits of the study participants.

1 Frank has said a couple of times he doesn't
2 think the data are very good. So I think that
3 the goal would be to try to pick up the
4 extremes so the people that take like long hot
5 showers basically, and drink a lot of tap
6 water and to try to distinguish them from the
7 other study subjects if that's possible.

8 **DR. CLARK:** Ann, thank you very much.

9 Scott.

10 **DR. BAIR:** Yes, I guess I'd like to also
11 thank people for inviting me. This has been a
12 very worthwhile and educational process for
13 me. I think the discussions over the last two
14 days have probably convinced those who already
15 recognize it at the table and elsewhere and
16 those of you in the audience that all models
17 are wrong. There are some models that are
18 useful.

19 So the goal here is to incorporate
20 enough uncertainty and analyze enough
21 sensitivity aspects that we come up with a
22 useful model that can be used by the
23 epidemiologists. So I don't want all the
24 discussion of the nitty gritty that went into
25 the making of the sausage to discourage people

1 that this can't be done. Because I, like Ann,
2 share a positive idea that this can be
3 accomplished. Having read the Tarawa Terrace
4 and the other reports that we were sent before
5 we got here, I was a little skeptical about
6 the amount of data that was available.

7 And through the discussions with Bob
8 and others there are a fair amount of data
9 that are present that can be used to help
10 constrain the models that I don't think have
11 been mined to their greatest extent yet. For
12 example, the grain size analyses, I think more
13 can be squeezed out of that just looking at
14 the percentage clay or looking at something as
15 simple as a uniformity coefficient or ratio
16 between D-60 and D-10.

17 I think being the geologist that Mary
18 mentioned, all three of my degrees, anything
19 that is deposited in water because of particle
20 size differences and settling through water,
21 is going to be anisotropic inherently. So I
22 think there's an anisotropy within each year
23 model layers that you may need to consider.
24 These are stacked channel deposits so they are
25 deposited in water. So I'd encourage you to

1 try to glean as much as you can.

2 The grain size data, there are
3 actually geophysical logs that we didn't get
4 to mention, SP logs and resistivity logs that
5 are giving you information that can be
6 interpreted to show that these are not
7 continuous layers, and they're in some of the
8 older wells, but I think that, too, needs to
9 be incorporated into the model either as an
10 uncertainty analysis, a what would happen if
11 this data point is correct and there's a hole
12 in the confining layer here or not. Getting
13 at the pumping test data, the slug test data
14 that Bob talked about and incorporating that
15 in the model I think is essential to get the
16 velocity fields pinned down a little bit.

17 Having said that, that y'all have a
18 lot of data to squeeze yet, I do think that
19 there are some simple pieces of data that you
20 can add within your timeframe to help you
21 lower the uncertainty in your model by adding
22 a couple monitoring wells and locations there
23 where water levels are sparse and then just
24 using that to help guide your model even
25 though you're going backwards in time, the

1 water level in the sparse areas probably has
2 not changed that much because it's not in the
3 middle of your well fields, and I'm thinking
4 specifically on the northeast border of the
5 model area.

6 Perhaps getting some tritium/helium
7 data would be useful to help get another full
8 velocity measurement like Mary talked about
9 getting stream discharge data to help
10 corroborate -- calibrate, corroborate --
11 what's going on. I think MODPATH is an
12 essential target of your future work, and it
13 wasn't in the Tarawa Terrace report, but I
14 think it should be an essential part.

15 And then the last thing I have, and we
16 really didn't get too great a discussion on
17 it, is the source term issues. For me one of
18 the biggest problematic areas you have is how
19 you're going to treat all these different
20 source terms. Are they going to be pulse
21 sources or are they going to be continuous
22 sources? If they're continuous sources, is
23 there known DNAPL at depth that can continue
24 to shed off dissolved phase TCE or PCE? What
25 are the initiation dates of those and how are

1 you going to bracket those in some sort of
2 uncertainty analysis?

3 That's about -- oh, yeah, one last
4 thing. Dump the air line measurements.

5 **DR. CLARK:** Scott, thank you.

6 Dan.

7 **DR. WARTENBERG:** I'm also going to thank
8 everyone. I found it fascinating to hear
9 about all the inter-season groundwater
10 modeling and the complexity and the difficulty
11 in obtaining accurate estimates. But as Ann
12 said, as epidemiologists we're used to
13 complicated problems and data that's not as
14 good as we want and are still able to move
15 forward.

16 But that having been said, I think
17 we've seen maybe the best data that can be
18 provided for this study because the better the
19 data, the more accurate would be the
20 epidemiological results, the more sensitive
21 the study will be. And also, fine scale data
22 are important in helping us resolve some of
23 the epidemiologic issues in terms of how the
24 exposed were related to outcomes.

25 I think that just speaks to the notion

1 of if it's at all possible to get the monthly
2 data to get an opportunity to try and see at
3 what stage in the pregnancy there is this
4 effect would be very important, although I
5 recognize that's going to be harder. And
6 there's always the opportunity to aggregate it
7 back up to whatever timeframes if needed to do
8 the analyses.

9 I think one of the other things that
10 would be useful to do which hasn't been talked
11 about as much is also to do some sensitivity
12 analysis from the epidemiologic studies in
13 terms of if they're different estimates based
14 on different assumptions. Those also can be
15 explored epidemiologically to see if there are
16 associations in different ways.

17 One of the challenges here is, I guess
18 there are a few challenges, there are a
19 moderate number of studies looking at TCE and
20 PERC and vinyl chloride in terms of cancer,
21 but there's much less in terms of reproductive
22 outcome. And being able to get a better
23 handle on that's pretty important. So I think
24 that trying to complete that picture, even the
25 cancer data right now is still very

1 controversial. But I think, again, it just
2 speaks to how important this study is in doing
3 as good a job as is possible.

4 I guess a couple other things to say
5 are that I support Ann's statement about
6 really asking the Navy to provide whatever
7 data are being requested and available to help
8 inform the study that that would be an
9 important component to try to understand
10 what's going on and trying to understand the
11 epidemiology of these compounds that we know
12 definitely affect people's health and to try
13 and better understand that.

14 I guess those are my main comments. I
15 just think again, just to reiterate, the
16 better data we can get the better the
17 epidemiologic data will be and the more
18 retrievable and reliable. I think that's an
19 important thing to try and strive for. Thank
20 you.

21 **DR. CLARK:** Thank you.

22 Peter.

23 **DR. POMMERENK:** Well, I'll say thank you
24 again for having me a second time on this
25 panel. I find a certain new perspective that

1 I hadn't heard about groundwater modeling
2 before, and I also heard some things that we
3 spoke about last time. And instead of
4 repeating again, I just want to keep it short
5 and want to reiterate that it appears critical
6 to this study that uncertainty is included
7 from the get-go.

8 From every aspect, starting upstream
9 from the mass that was deposited, when it was
10 deposited to have some measure of uncertainty
11 in all these estimates and how they propagate
12 through our model and whether it's the
13 simplified physical model or linear control
14 theory model or highly complex transport
15 model, the uncertainty that is upstream will
16 propagate ~~for~~ [through -ed.] the model and
17 will possibly skew it.

18 In the end we need to be, a logical
19 study needs to be able to distinguish certain
20 levels of exposure, whether it's not exposed
21 versus exposed or whether it's a little
22 exposed, medium exposure, high exposure and
23 just providing a number will not help that
24 cause. So it needs to be accompanied by some
25 level of certainty in those numbers.

1 So with that in mind from my
2 perspective certain things that will have to
3 be addressed in Hadnot Point is the pumping
4 schedules, having a well operate 24/7 over a
5 month at a reduced ~~apportion~~ [proportional -
6 ed.] flow rate may not be appropriate, and you
7 may want to look into at least a cursory
8 analysis of how using 12-hour stress periods
9 may affect the outcome.

10 For the Holcomb Boulevard wells you
11 may want to use 12-hour stress periods because
12 that's the typical amount of time they operate
13 versus Hadnot Point, those wells seem to
14 operate in ^ [continuously -ed.] for a week or
15 two or even a month. Anyway, it would be
16 worthwhile looking at how this type of model
17 or approach will affect the outcome and
18 uncertainty in the study.

19 And then secondly what I mentioned
20 earlier, we need to look at some of the issues
21 of volatilization up at the treatment plant.
22 You know, just a cursory analysis and say it's
23 significant or not. But it should be on
24 record somewhere because that question may
25 come up at one point.

1 And I think moving downstream from
2 there, again, it's a lot about uncertainty.
3 We need to wonder how much detailed modeling
4 we have to do in the distribution system.
5 Will that increase certainty in our, in the
6 end or is it not worthwhile by the time we get
7 to what [we want -ed.]^ . Anyway, that's all I
8 have.

9 **DR. CLARK:** Peter, thank you.

10 Dick.

11 **DR. CLAPP:** Thank you all for teaching us a
12 lot. I think some of you mentioned yesterday
13 there are boundary layers between the
14 engineers here. Well, there are tribal
15 differences I think between ^ [various -ed.]
16 epidemiology tribes. It's fascinating to
17 listen and learn from you all.

18 To me, I would like to reiterate the
19 points that Ann and Dan made from the point of
20 view of an epidemiologist. When you get the
21 final number that you'll use to assign a dose
22 or an exposure to a particular subject in a
23 study, that's the result of a lot of
24 phenomenal work, and it will have error bars
25 around it.

1 But there is still going to be a
2 central tendency for that number. I know it's
3 a sort of probability density function that
4 goes along with that number. Our goal is to
5 see that that's as peaked as possible, not as
6 flat and as compatible with anything as
7 sometimes happens. So that's the goal here,
8 and I think everyone has established that
9 that's what the modeling effort is going to
10 lead to. So anyway, I think that's in good
11 hands. As Ann said it's state-of-the-art
12 work, and I commend the ATSDR folks for doing
13 it.

14 I'd like to mention I think there is a
15 particular problem which is this Hadnot Point
16 to Holcomb Boulevard interconnects during four
17 months for a period of years from 1972 to 1987
18 where the problem is or a lot of the problem
19 is in the distribution system at least. And
20 so that seems to me to be a tractable problem,
21 that it's not as big as or hopeless as some of
22 our discussion today or yesterday might have
23 made it seem, especially today, I guess.

24 So I'm optimistic. I think this is
25 going to work. I think that the process that

1 we've engaged in is going to have a fruitful
2 outcome. I think it will be useful to
3 veterans, the people who lived and worked at
4 Camp Lejeune, and that we shouldn't lose sight
5 that that's what this is all about. And I
6 think some aspects of this we learned, for
7 example, there may be a simpler solution than
8 we realized, one of which can be done this
9 weekend. We may have data next Monday I think
10 from him, Dr. Aral. Without being too silly,
11 I'd like to say I think this is a useful
12 exercise that's going to lead to an important
13 finding and glad to be a part of it.

14 **DR. CLARK:** Thank you.

15 Ben.

16 **MR. HARDING:** Thanks, Bob. I want to thank
17 ATSDR for allowing me to have this
18 opportunity. I really learned a lot in the
19 first pass, and I've learned a lot from this
20 one. I thank all the panelists, too, for
21 allowing me to poach on your territory and
22 talk about things I don't really know that
23 much about.

24 And I want to say how remarkable
25 Morris is. I don't know what, does he drink

1 Tension Tamer Tea or something like that?
2 Your ability to stay calm in the face of all
3 this is really impressive.

4 **MR. MASLIA:** Thank you.

5 **MR. HARDING:** I'd like to know what it is.

6 Bob, I'm not going to say anything
7 about, or not much, about what happens below
8 the ground here. I do think it's feasible for
9 this work to contribute a lot of important
10 knowledge, at least at the exposure level.
11 And I'll leave it to the epidemiologists to
12 work from there. So I think there's a good
13 foundation, and it's feasible to complete this
14 successfully.

15 I would suggest, and I think you
16 probably already intend to do this, that you
17 step back and re-scope your remaining efforts
18 at this point. And from the program scenario
19 I think Walter laid out the components that
20 you need to think about quite well: wellhead
21 concentrations, the interconnection scenarios,
22 water use and then the system operation rules.

23 And with regard to the water
24 distribution, both the large view I agree with
25 Morris' breakdown and essentially the

1 difficult problem is the interconnections,
2 which others have mentioned here. In doing
3 that I suggest that you should use a detailed
4 hydraulic network model, an extended period
5 simulation of that.

6 There's no sort of technical or cost
7 problem with doing that. You already have it
8 essentially. That you will need to extend
9 your scenarios over potentially several months
10 depending on what you see in the tanks because
11 it can be a long time before the tanks clear
12 out.

13 In all of the phases of the work above
14 ground, we're going to need to have what you
15 call a simple mixing model, but it's actually
16 more complicated than that as Peter has
17 mentioned. So we need to have what I call a
18 well operation well supply model that will
19 take into account if there are hydraulic
20 effects on particular wells.

21 And I think you should develop an
22 informed model of well operations, as informed
23 as you can make it. It'll probably have to be
24 stochastic at some point, but you should
25 inform it as best you can with what you know

1 about the way they operated, the wells.

2 I think you should use the super-
3 position approach that Walter mentioned. It's
4 essentially similar to the Murphy method that
5 was portrayed. You know, he called it an
6 exposure index. We call it transfer
7 coefficients.

8 But that approach will allow a low
9 cost and rapid recalculation of the exposure
10 statistics which will happen because the
11 groundwater people will come up with new
12 numbers, and then the epidemiologists will ask
13 for new thresholds. I know. I've been to the
14 rodeo before so, and being able to recalculate
15 this in a short time is really important.

16 I think it's okay. I think it's
17 feasible and proper to be able to calculate
18 your exposure statistics over a one-month
19 period. That's been a real request from the
20 epidemiologists, but I wouldn't go any shorter
21 than that. I think you have to model a water
22 distribution system on an hour to even -- EPA
23 did a model of minutes if it has to get the
24 convergence.

25 But you have to model in a short

1 period to get the dynamics of the system. You
2 can roll it up to a month but no shorter, I
3 think. ^ a quarter but because you need the
4 resolution as long as you bear in mind there's
5 some additional uncertainty.

6 With regard to the control theory
7 approach, I thought it has a lot of use for
8 developing confidence in the physically-based
9 model, but that we should use a physically-
10 based model for the basic work. And I think
11 there's other reasons why the control theory
12 approach isn't appropriate because we can't
13 get a complete set of wellhead concentrations.
14 But it really was sort of nice to see how well
15 it agreed with the physically-based model.
16 That was interesting.

17 Echoing what Peter said, you should
18 focus on uncertainty at every step from start
19 to finish. I won't try to tell you how to do
20 that, but I think ultimately it has to be some
21 kind of Monte Carlo numerical approach. At
22 least make an analysis of sensitivities if
23 you're not, if you're going to treat things as
24 point values.

25 Overall, I want to say this. There's

1 hundred of thousands of people, and I guess
2 Frank said potentially up to a million people
3 that may have passed through this site during
4 this period that are interested in this event
5 and potentially exposed. And it's a bad thing
6 that's happened, but we should do our best to
7 learn from what happened and not repeat this
8 mistake. And whatever we can gain medically
9 and scientifically we should do that.

10 If this is done well, future people
11 will make medi-analyses of these results with
12 new information about the populations. So I
13 think it's really, really worth committing the
14 time and effort that are necessary to get this
15 done right, whatever right means, but to get a
16 good foundation in every spurt or step. I
17 mean, the flow model is going to be the
18 fundamental foundation that probably won't
19 change all that much. And as you build up
20 from it maybe some things will be refined, but
21 I really do think it's worth it.

22 You need to take the time and the
23 money to do that. With respect to time, I
24 think a year for the water distribution
25 modeling should be enough, and maybe you could

1 do it faster. I mean, we've done similar
2 things in a year. I think if you set your
3 mind to it, you could do it faster, but
4 there's a real value in rethinking things
5 every once in awhile.

6 But do focus on the essentials, just
7 what you essentially need to do to get the end
8 result. Try to avoid digression into details
9 where they aren't relevant. But I think
10 you've done a real good job, and I really do
11 appreciate the opportunity to be here with all
12 the panel members and your tolerance.

13 **DR. CLARK:** Thank you, Ben.

14 Rao.

15 **DR. GOVINDARAJU:** I, too, would like to
16 thank ATSDR and all of you for contributing to
17 my learning. I really enjoyed all this. I
18 have some recommendations, but they're not
19 necessarily out of the charge that was laid
20 down to us.

21 First, I would like to say that I
22 found out that more data has become available
23 very recently, 200 new ~~USG~~ [UST -ed.] reports
24 and many other data coming online. And this
25 data is not likely to be immediately ~~be~~ [-ed.]

1 used in a model. It's not in spreadsheet form
2 and all cleaned up. So by the time all that
3 data discovery from all this takes place, I
4 suspect it will take some time and I do not
5 know how large a team you have, how many
6 person hours you can throw at it. So I'm
7 going to suggest that December 2009 does not
8 look likely to me, at least one more year and
9 maybe more. But that's something I wouldn't
10 be able to tell. So that is in terms of the
11 timeline issue.

12 I'm also not comfortable, I would not
13 like to answer the question and say can we
14 promise a plus-minus half magnitude for
15 concentrations, which actually may not be
16 possible for such a complex system even with
17 the best methods available and even if we had
18 a lot of very good data. So I think what the
19 focus should be on is trying to reduce one
20 certainty to the extent possible using
21 whatever that can be done. Use the best
22 methods and so on. I think that would still
23 be useful even if it did not meet this plus-
24 minus half magnitude target.

25 I'd also like to say that I do not

1 think that all quantities that are produced,
2 all the things that are predicted or hind-
3 casted, let's say, they will be done equally
4 reliably. Some things will be done better,
5 and some things will not be done as well. So
6 renewed concentrations I'm not sure we'll ever
7 reproduce, but perhaps some we need to drop
8 the averages or different averages you could
9 do perhaps more reliably. So I feel that all
10 the information that we have should be used ^
11 uncertainty which has been pointed out as
12 being very crucial.

13 So right now we have uncertainty from
14 the groundwater models which is reflecting,
15 which is trying to predict concentrations in
16 these wellheads, and then this is going to be
17 translated or propagated into the distribution
18 network. But in between there's a step at the
19 treatment plant. I do not know how these
20 concentrations ^, and I do not see much -- and
21 we talked about it -- but I do not know what
22 work has be done about that, but that's
23 potentially useful.

24 Regarding the models I think the
25 models that you have selected, which is

1 MODFLOW, ~~MPT~~, [MT3DMS -ed.]. the ^ [Ga. Tech -
2 ed.] code for ~~selu~~ [solute -ed.] transport,
3 EPANET, ^ [and -ed.] what have you. I think
4 these are all fine models. I have no, I guess
5 I have no objection to these models. Any
6 simpler model you want to use that is fine,
7 too, if it does the job well.

8 Now for the EPANET water distribution
9 model, when you are trying to get
10 concentrations at the endpoints, I think one
11 of the greatest challenges is going to be to
12 try to reconstruct how to disaggregate this
13 one-month quantity that is being given to you
14 from the groundwater side to a daily or an
15 hourly time schedule like has been mentioned.
16 ^ calibration work and with the expectation
17 that patterns haven't changed, I feel it
18 should be possible to reproduce the
19 variability within the month.

20 I mean, you can consult that volume
21 within a month but you appropriate so that you
22 reproduce some of this variability. And then
23 looking at this variability over time and
24 perhaps over the front realizations which come
25 from different concentration values from the

1 groundwater, if you look at all of these, then
2 I think some meaningful decisions can be made
3 about what the exposure was, how likely the
4 concentrations to have been exceeded over
5 different time windows and so on. So a good
6 statistical analysis I think could be done and
7 could be quite revealing to the epi people.

8 Well, I think those are my oral
9 comments. I see there is a lot of hard work
10 that has been done by the ATSDR team, and I
11 have a feeling there's quite a bit more to
12 come also. Thank you.

13 **DR. CLARK:** Lenny.

14 **DR. KONIKOW:** Thank you. I'm going to keep
15 my comments from the ground level down and
16 focus basically on the one test. How do you
17 get or reconstruct the concentrations
18 unloading from the wellheads? And what I see
19 is the task at hand is enormously difficult,
20 and it's a challenging one, but it's very
21 important.

22 And it's very important that you
23 succeed, and I think you can succeed, but
24 there'll be some errors and uncertainty
25 associated with that. But if you recognize

1 that I think we can pass that information on
2 and let the next group above ground, they can
3 do something with that.

4 As you go forward and develop the
5 models and develop the insight, I think it's
6 very important that you clearly indicate all
7 the assumptions that underlie it and
8 conceptual models that we use to formulate
9 that. And I think that will help in your
10 defense of it in the future, and it would help
11 enable people to understand it.

12 Now, I've spent quite a bit of time in
13 Scott's proverbial modeling sausage factory so
14 I tend to see all these difficulties, and I
15 get very concerned about them because they do
16 affect the answers, and I have a few detailed
17 comments related to that.

18 But the other kind of big picture
19 thing I see here is that you've essentially
20 completed the work at Tarawa Terrace, and I
21 could nit pick a lot of little things in
22 there, but basically, I think that was a
23 successful effort. You did a good job there
24 within its own right was a very complicated
25 problem.

1 What concerns me here is that the
2 Hadnot Point-Holcomb Boulevard I see another
3 one or two orders of magnitude of complexity
4 here, and so I do get concerned. Is this
5 whole thing doable? And that's a reasonable
6 question to ask. I don't have the definitive
7 answer, but I do think you can do something.
8 I think what you do can be useful.

9 I think basically, I think you can
10 succeed within a certain framework, but maybe
11 keeping in mind what was done and what was
12 able to be done at Tarawa Terrace, what's able
13 to be done and our success in groundwater
14 science with groundwater flow modeling.
15 Transport modeling again just is another level
16 of complexity. So as I tell some people, the
17 secret to successful ~~solu~~ [solute -ed.]
18 transport modeling is to lower your
19 expectations.

20 And I think that's something we have
21 to do. We're just not, all the difficulty in
22 groundwater flow modeling will have that, but
23 we could do it. We're not going to be able to
24 do as well with transport. There's too many
25 other processes involved and there's too many

1 additional unknowns. So what this gets at
2 then, and I've worked in the sausage factory,
3 but I'm also a sausage salesman, so I don't
4 want to discourage you from this, and I'm
5 trying not to discourage you.

6 I think it is a valuable path to
7 follow, and you will learn a lot and on. But
8 be that as it may, with this complex approach,
9 as several of us have said earlier, it has to
10 be supplemented with simpler approaches both
11 to see if they could provide the necessary
12 information as well as to provide cross-checks
13 against the very concas (ph).

14 As we said again many times, no matter
15 what we do with the models, there's still a
16 very limited set of observations of
17 concentrations against which we could compare
18 the model results. So we have this enormous
19 field of a couple of decades of no data on
20 concentrations. So we've got to take a
21 couple, you should take a couple of different
22 paths.

23 The linear control theory I think is
24 certainly worth pursuing and get as much out
25 of that as you could. Other simple ways that

1 we've talked about which would encompass some
2 coupling of groundwater flow modeling with
3 MODPATH modeling and with very simple
4 interpolation extrapolation I think would be
5 very useful also, and I think you could do a
6 lot with that.

7 I think you could learn a lot from
8 using MODPATH more than was done in the Tarawa
9 Terrace approach. With this lack of data I
10 think you have to keep mining, searching,
11 doing what you can to get more data if it's
12 out there, and if it's available. Because one
13 extreme, and again, I don't want to sound like
14 an academic researcher who just always wants
15 more data, but one of the difficulties I've
16 had in doing this review in constructing my
17 comments was -- I think it was Dave mentioned
18 -- it's very early in your phase.

19 And my focus really has been on the
20 wellhead concentration, how we get there. And
21 yet we've had no document on the hydrogeologic
22 framework yet, no transient flow model yet, no
23 transport model yet. So it's hard to comment
24 on them because that's what's going to get us
25 to the wellhead concentrations.

1 So one recommendation that was
2 mentioned was that somewhere down the line
3 when you get further into that, but not too
4 far into it, get maybe a smaller group of
5 expert peer panel to look over your shoulder
6 and give you some advice and help maybe guide
7 you in a more efficient -- and by more
8 efficient I mean you're always going to have
9 some deadline facing you. So you want to get
10 this done as well as possible and in as short
11 a time as possible. And I think peer review
12 is a very useful way to help you do that.

13 On the data picture a lot of people
14 don't like to hear this, but consider getting
15 more data. I mean collecting more data so,
16 but before you do that you've had an enormous
17 amount of money spent on installation
18 restoration programs there. Have you mined
19 that for all the data that's available?

20 In the report I saw there was a 40-day
21 tracer test done at one of the sites, which I
22 can't remember. I mean, that should have
23 gotten you some effective porosity and
24 dispersivity data if they did it well. Is
25 that data available to you and have you looked

1 at it? They must have to do the kind of work
2 they do, and they must have taken some cores.
3 They must have looked at some of the clays and
4 the confining layers.

5 Did they measure any hydraulic
6 conductivities or porosities?

7 **MR. FAYE:** Was that rhetorical or do you
8 want an answer?

9 **DR. KONIKOW:** I don't want an answer right
10 now, but it wasn't rhetorical either. These
11 are things I want you to think about, and I'm
12 sure most of you've already thought about it,
13 but these are things that are just kind of
14 popping out of my mind now.

15 On the modeling and the work that's
16 done so far, again, I'm very concerned about
17 up to now -- I know it's preliminary still --
18 it's locking into one foot per day as a
19 hydraulic conductivity for the clays and for
20 all the clays.

21 I mean, that bothers me. One of the
22 things we talked about doing sensitivity
23 analysis. In your steady state, pre-
24 development flow model, those heads are not
25 going to be sensitive particularly to those

1 values, but your transient flow model it will
2 be, and in your transport model even more so,
3 that value is so few.

4 Rely on locking it into those values
5 based on the sensitivity test in your steady
6 state flow model, you may be making a big
7 mistake. And again, that's something I
8 mentioned before is when you go beyond the
9 steady state, you may have to re-examine
10 almost everything because what worked there
11 may not work for transport.

12 In a transport analyses again one of
13 the things that has certainly been highlighted
14 in the last 20 years or more is the control
15 and the importance of spatial heterogeneity in
16 the formations. And you're dealing with
17 models at the moment.

18 You're assuming each layer, each unit,
19 is homogeneous, and I'd like you to explore
20 the data to see if there are ways to not only
21 get at the spatial variability but other
22 aspects of heterogeneity including channeling
23 and connectivity of the sediments because
24 every study where there was detailed data
25 showed that this was the controlling factor on

1 ~~solu~~ [solute -ed.] transport. So if at all
2 possible, pay a little more attention to that.

3 Then there's all the uncertainty with
4 reaction, ~~absorption~~ [adsorption -ed.], fate,
5 you know, ~~absorption~~ [adsorption -ed.], decay
6 and all those other terms which we don't want
7 to get into right at the moment. But again,
8 like I think it was Scott mentioned his
9 concern about estimating the source terms.
10 Again, what's more critical for ~~solu~~ [solute -
11 ed.] transport model than how much gets in and
12 when and where.

13 And I didn't see all the answers yet
14 in the presentations here or how the approach
15 that was taken and described will actually get
16 to an estimate for the source term in the
17 model and how they'll be done. At Tarawa
18 Terrace you did a mass loading which I would
19 much rather see defining a source
20 concentration associated with the fluid that
21 goes in the model. Because otherwise you get
22 some conceptual inconsistencies that I think
23 need to be explained. So this gets into other
24 issues, but again be careful with that source
25 term because that's very critical and very

1 important.

2 So with that I guess I'll pass the
3 mike.

4 **DR. CLARK:** Lenny, let me thank you very
5 much.

6 Randall.

7 **DR. ROSS:** First, I'd like to thank ATSDR
8 and Morris for the opportunity to come and be
9 with such a talented group of individuals and
10 learn. And I had a professor that once said
11 water level maps are a figment of the artist's
12 imagination. And I'd say the same could
13 probably be said about groundwater modeling
14 results. But with that in mind it's also the
15 best that can be done. I don't want to say a
16 necessary evil, but it is. It's the best
17 answer that one can come up with with
18 confidence. And I think that's true.

19 One of the things about data gaps,
20 modeling, one of the benefits of modeling is
21 it forces you to look at your data, look at
22 what you have and identify your data gaps.
23 And I think Scott hit on this a little bit.
24 There may be some data gaps that come up in
25 the initial parts of the modeling exercise

1 that tell you where you need more information,
2 have better control on the situation.

3 With regards to the charge, with
4 respect to the question did the methods
5 provide an adequate level of accuracy and
6 precision, using Dr. Faye's definitions of
7 precision and accuracy, I'd say for precision
8 probably, for accuracy at Tarawa Terrace
9 probably, for Hadnot Point I'll refrain from a
10 final answer on that.

11 I'd say that the Tarawa Terrace
12 exercise represented one of the best case
13 scenarios that we've had an opportunity to see
14 with respect to coming up with concentrations
15 for exposure that will keep you folks happy.
16 And that's one thing I have written down here
17 is listen to the epi folks.

18 If you have another meeting like this
19 I'd say the first 15 minutes should be the epi
20 folks re-impressing upon all the people that
21 work below ground and above what they're
22 looking for. If it's enlightening to me to
23 hear that high, middle and low are acceptable.
24 And with that in mind I'd say whether or not
25 you could reach the accuracy, probably. And

1 that's a good thing.

2 Looking through the previous panel's
3 comments after we made our comments I noticed
4 there were a few things that we commented on
5 that in particular Dr. Konikow identified in
6 the last panel meeting that didn't seem to be
7 fully addressed. And that leads me to the
8 question of exactly what will become of the
9 comments that were submitted today and how
10 that will be addressed I guess.

11 Then I have a note here that says
12 listen to the geology. To go back to what Dr.
13 Hill said, basically. And this with respect
14 to including two marginal aquifers and a
15 confining unit in the same layer. I mean,
16 that's a no-no, and I think pretty much all
17 the modeling folks here, the hydrogeologists,
18 kind of cringed when they saw that. And there
19 was a reason for that because it flooded, the
20 nodes were flooded I understand. But as Dr.
21 Hill also said, don't do that. Fix it some
22 other way I guess.

23 I would say it's, I had a comment here
24 about the plus or minus three feet and the
25 plus or minus 12 feet, and I'd say that if

1 there are wells that haven't been surveyed, I
2 think it's well worth surveying them now.
3 These could provide valuable data in the
4 future.

5 And along those same lines one of the
6 recommendations that people get tired of
7 hearing me suggest is the implementation of or
8 deployment of pressure transducers. Yeah,
9 they produce a whole lot of data, but at the
10 same time they can provide a lot of insight
11 into how the system reacts to pumps shutting
12 on and off.

13 You can't do it in hindsight, but
14 hindsight being 20-20, we can look ahead and
15 say that might be a useful tool that could be
16 deployed. Pressure transducers in select
17 locations to give you a better understanding
18 of how the system reacts, hydrogeologic system
19 in general.

20 There were several comments I guess
21 that I included in our written comments, but
22 something then to consider with the, more of
23 the worst-case scenario I guess which would be
24 the whole Hadnot Point modeling exercise, not
25 worst-case scenario but certainly not as

1 friendly and nice. The looking at leakage
2 from your domestic production lines, the water
3 lines. Ten percent's not an uncommon number
4 that you hear batted around the modeling
5 community, but which could be a significant
6 number.

7 Likewise for sewer lines, they pump a
8 boatload of water out of the aquifer, well, if
9 you lose ten percent or 20 percent of that
10 usually the sanitary folks don't really care
11 if they don't see it and if nobody's
12 complaining that they're basements are
13 flooding. That could be a significant input
14 into the model as well and nobody measures it
15 or likes to.

16 Degradation rates, you've got to be
17 careful there. It's going to be completely
18 different I believe than the exercise at
19 Tarawa Terrace. There you really don't have
20 evidence that the bugs were really happy.
21 There's not a large quantity of -- at least I
22 haven't seen -- VC, DCE and compounds like
23 that, nor of the geochemical data that
24 indicate that the bugs were happy for reducing
25 conditions. I think there'll be a lot more of

1 that associated with the DNAPL sites as I'm
2 sure they are.

3 And that leads right into the source
4 term. You've got bugs that are munching away
5 at the dissolve[d -ed.] phase, but there's no
6 doubt in my mind just looking at the numbers
7 in a cursory manner that, I mean, you've got a
8 -- I've used the term boatload three times now
9 because I like it. There's an unknown, yet
10 probably very large quantity of dense ^
11 [nonaqueous phase -ed.] ~~disphase*~~ liquid TCE
12 and PCE in the subsurface especially below the
13 dry cleaner. How that will be handled as a
14 source, that'll be interesting, and I think
15 will have a significant impact maybe. Maybe.
16 It has an impact with respect to the longevity
17 of the source and remediation talk, but maybe
18 not necessarily on the high, middle and low
19 concentrations that you folks are really
20 looking for.

21 Echo what was said earlier about the
22 bulk density issue. It looks like there was
23 an error early on that was carried through.
24 It could be a nomenclature issue, but going
25 back to that original article and tracing it

1 through the documents, I think there's a, the
2 retardation factor in the model would be
3 modified by about 25 percent probably, just a
4 ballpark, back-of-the-envelope kind of
5 calculation.

6 Source issues we've talked about
7 transducers. Thank you for the opportunity to
8 participate in this.

9 **DR. HILL:** Can I say three words?

10 **DR. CLARK:** Sure.

11 **DR. HILL:** Two significant digits.

12 **DR. CLARK:** Words to live by.

13 I'd really like to thank all the panel
14 for your participation and your outstanding
15 insights. It's been a pleasure to work with
16 all of you. I'd certainly like to thank the
17 audience, too. We had some very good input
18 from a lot of the people who've been here and
19 observers, Dr. Aral. We certainly appreciate
20 the ATSDR staff and Liz, for all your help.
21 So it's made it possible to do this.

22 Morris, would you like to say a word
23 or two?

24 **MR. MASLIA:** Are you giving your
25 recommendations?

1 **DR. CLARK:** Well, I can. I didn't know if I
2 was allowed to do that as a panel member.

3 **MR. MASLIA:** Yes, definitely.

4 **DR. CLARK:** Very few. I thought everybody
5 did an outstanding job in recommendations, and
6 I support all that was said. The only things
7 that I thought were worth maybe re-emphasizing
8 for the fact that it seems to me that the
9 epidemiological study should probably go
10 beyond just child [and -ed.] in utero studies.
11 ~~That~~ [and -ed.] there's significant exposure
12 to adults and that's just almost totally
13 unknown.

14 And some of the levels that adults
15 have been exposed to are almost unbelievable.
16 I was looking at some of the vinyl chloride
17 levels that were pumped from one of the wells
18 in there, and when I was working on this sort
19 of thing with EPA, this would have been
20 frightening stuff. So I think that's
21 something that probably needs to be explored.

22 I still think that some of the
23 degradation byproducts issues have not been
24 explored thoroughly and should be. I think
25 ~~it's,~~ like the degradation rate [rates -ed.]

1 shown in the manual are a lot slower than
2 would be of concern in [-ed.] [- ed.] in a
3 distribution system, but it depends on where
4 you start from.

5 And I think it's something we were
6 always concerned with in our studies is just
7 how fast did some of these compounds degrade
8 the vinyl chloride in it. What would the
9 implications for that be? It wouldn't take,
10 ~~wouldn't be~~ [-ed.] very much vinyl chloride to
11 really have an impact on the outcomes in an
12 epidemiological study.

13 Another thing I wanted to mention was
14 the fact that I think you've missed an
15 opportunity to look at some direct exposure
16 data in terms of CHMs [THMs]. I know I gave
17 up on that earlier because I know Dave and ^
18 looked at it, and they didn't have the GC
19 traces so they sort of pushed it aside. But
20 looking at some of what I've seen, it seems to
21 me that's an opportunity to actually look at
22 direct exposure and transport in the
23 distribution system. I would encourage you to
24 go back and look at that very carefully and
25 see if there isn't some way to reconstruct

1 that. And I certainly would help you with
2 some of my contacts at EPA when you get into
3 some of the analytical chemistry issues. So
4 with that I'll conclude and thank everybody.

5 And Morris, you want to make a few
6 comments?

7 **MR. MASLIA:** I wanted to thank all the
8 people who participated in the panel. It's
9 obvious even the preliminary work is a large
10 volume of information for you to digest in the
11 short period that we gave you and then provide
12 us with feedback that we can implement and use
13 to carry the project forward to a successful
14 completion, so thank you very much for your
15 time and effort.

16 I also wanted to thank Bob Clark for
17 stepping in at the last minute and chairing
18 and guiding the panel, which he was not
19 expecting to do just a couple of days ago. So
20 that was a benefit to us. And I do agree. I
21 think was it Lenny that made the suggestion
22 and actually I was going to bring it up, but
23 since you said it, it's good is to reconvene
24 perhaps a smaller group as we get to different
25 aspects or phases, and sort of looking over

1 our shoulder and critiquing those aspects
2 rather than waiting a whole long time and
3 bringing a larger group together. And I think
4 that probably will provide us with much more
5 valuable input in a shorter time period. So I
6 thank you for bringing that up. It's a very
7 worthwhile suggestion.

8 And to answer Dr. Ross' question about
9 what happens is we will put a draft report
10 together similar to the one that we did. We
11 tried to, I think actually this panel was much
12 more succinct in their final recommendations
13 than the first panel, which is easier for us
14 to, and then we tried to implement it to the
15 best of our ability both in technically as
16 well as time and effort and money.

17 But again going back to Lenny's
18 suggestion I think if we do have smaller
19 groups of technical experts looking over every
20 so often that's easier to make sure we don't
21 miss anything or overlooking something that's
22 important. So thank you to everybody, and
23 thank you to all the administrative staff for
24 assisting us and thank you to our technical
25 staff who have spent at least the last months

1 just administratively putting the panel
2 together with all the material.

3 **DR. BOVE:** I want to thank all of you. I
4 think this has been very valuable to the
5 epidemiologists, both myself, Perri and I
6 think the epidemiologists on the panel learned
7 quite a bit today. So thank you very much. I
8 think your input was great and I think will
9 help the study immensely.

10 **DR. HILL:** Thank you.

11 **DR. CLARK:** With that the bus from the hotel
12 comes at 3:30, doesn't it?

13 (Whereupon, the meeting was adjourned at
14 3:12 p.m.)
15
16

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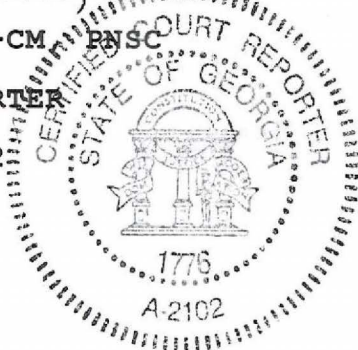
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I further certify that I am neither kin nor counsel to any of the parties herein, nor have any interest in the cause named herein.

WITNESS my hand and official seal this the 19th day of July, 2009.

Steven Ray Green, CCR
STEVEN RAY GREEN, CCR, CVR-CM, PNSC

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2